Construction of pilot Low Cost Houses (LCH) Project for the Disaster Families of Bangladesh

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READING CODE

The document is organized into chapters, which are identifiable by the logo and the title displayed in the bottom right of each page :

Materials Tools Site / Surroundings Building Maintenance

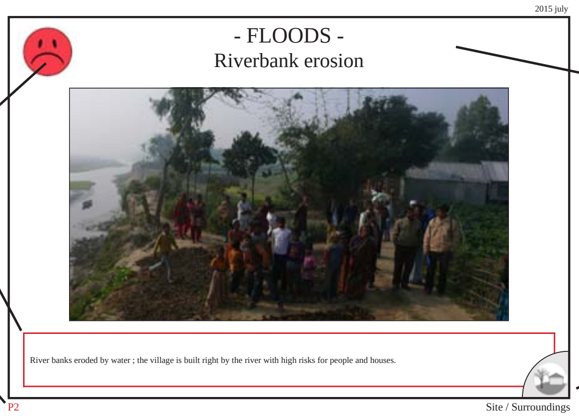
Reading order within each chapter is then the following :
- the color code specifies whether the page topic concerns problems (P)*, or solutions : local solution (ls)**or innovative solution carried out by the project (is)***:

2.The red colored icon shows that we are facing a problem.

3. Problem identifying number.

4. Title of the problem.

1. Chapter.



2015 july

- FLOODS -
Riverbank erosion

River banks eroded by water ; the village is built right by the river with high risks for people and houses.

P2

Site / Surroundings

2. The yellow smile shows that the board it's about a solution.

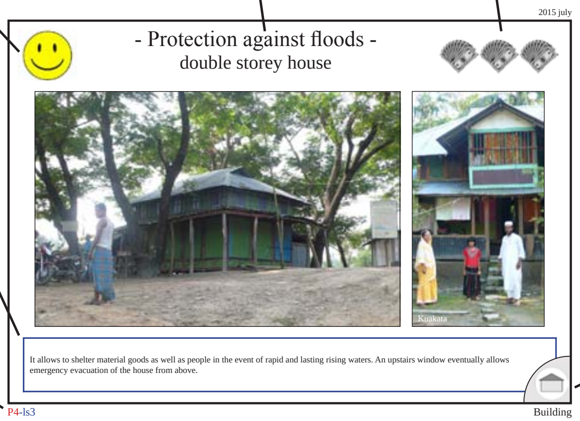
3. Blue frame = local solution. Green frame = innovative solution introduced by the project.

4. Identifying number of the solution and of the related problem (P1, P2, ...).

5. Title of the solution.

6. Solution cost index.

1. Chapter.



2015 july

- Protection against floods -
double storey house

Kuakata

It allows to shelter material goods as well as people in the event of rapid and lasting rising waters. An upstairs window eventually allows emergency evacuation of the house from above.

P4-ls3

Building

For all the chapters, each solution (local or innovative) refers to a problem (P1,P2,P3, etc.).
The number of problems as well as the related solutions will be increasing in the futur with new assessments, scouting and all along the project progression.
At the top right of each page is also listed the date (year, month), in order to easily update the documents into new versions.

*Problem

** local solution

*** innovative solution

💵 = cheap solution

💵💵 = slightly expensive solution

💵💵💵 = expensive solution

SUMMARY

Materials

CONSTRUCTION MATERIALS LOCALLY AVAILABLE			
1	sand	5	water - retention/recovery
2	pebbles, gravels	6	wood, various plants
3	stones, shingles	7	fibres
4	earth	8	binders

SUMMARY

Tools

VARIOUS TOOLS			
ls1	for earth construction		
ls2	for cob		
ls3	for fibres, small branches, ...		
ls4	for wood		

SUMMARY

Site / Surroundings

	P1 LANDSLIDES		
P1-ls1	plantations		
P1-ls2	steep lands plantation systems		
P1-ls3	ground holding by coating : sand bags		
	P2 FLOODS **Riverbank erosion**		
P2-ls1a	wave breaker		
P2-ls1b	wave breaker		
P2-ls2a	light embankment protection		
P2-ls2b	embankment protection		
	P3 FLOODS **Stagnant water**		
P3-ls1a	plinth		
P3-ls1b	plinth		
	P4 STRONG WINDS		
P4-ls1	protection through trees		

SUMMARY

Building

P1 STRONGS WINDS **Complete roof wrenching : house + veranda**			
P1-ls1	separate roofs		
P2 FLOODS **Water penetration through the door of the house**			
P2-ls1	water barrier on the door sill	P2-is1	raised internal floor
P3 RECURRENT FLOODS **High rising water / building in submerged area**			
P3-ls1a	stilt house		
P3-ls1b	stilt house		
P3-ls1c	stilt house		
P3-ls1d	stilt house with outdoor terrace		
P4 FLOODS **High risk of damage for goods and inhabitants**			
P4-ls1	light mezzanine system		
P4-ls2	platform, raised furniture		
P4-ls3	double storey house		
P4-ls4	floating roof		
P5 FLOODS **Wall base damaged**			
P5-ls1	house upon earth platform		
P5-ls2	staircase platform		
P5-ls3	high platform and overhanging roof		
P5-ls4	wide platform and overhanging roof		
P5-ls5	platform with stone reinforced edge		

P5-ls6	platform and mixed walls		
P5-ls7	platform protection with soil plaster		
P5-ls8	platform protection with plastic sheet		
P5-ls9	platform protection with textile		
P5-ls10	platform protection with stones		
P5-ls11	platform protection with fired bricks covering		
P5-ls12	platform protection with cement mortar covering		
P6 STRONGS WINDS **House bended / laid down**			
P6-ls1	emergency solution : raising of a part of the house	P6-is1	short bracing in the corners
P6-ls2	emergency solution : material recovery and reconstruction of a temporary shelter	P6-is2	short bracing in the corners
P6-ls3	outdoor protection against tipping		
P6-ls4	double long wall bracing		
P6-ls5	long wall bracing		
P6-ls6	long wall bracing		
P6-ls7	stilts bracing		
P6-ls8	reinforcement of stilt walls with long poles		
P6-ls9	door bracing		
P7 ROTTING OF WOODEN POLES **Poles planted directly into the wet ground**			
P7-ls1	bambous protection process	P7-is1	piles protected from ground humidity (Katla)
P7-ls2	pole base wrapped up in plastic		
P7-ls3	local foundation under poles		
P7-ls4	piles protected from ground humidity (Katla)		
P7-ls5	piles protected from ground humidity (Katla)		
P7-ls6	piles protected from ground humidity (Katla)		
P7-ls7	piles protected from ground humidity (Katla)		

P7-ls8	piles protected from ground humidity (Katla)		
P7-ls9	poles doubling (fuse)		
P7-ls10	reinforced concrete columns		
P8 TERMITS **Attacks on wooden elements (poles, roof, ...)**			
P8-ls1	roof disconnected from the wall by fired bricks		
P8-ls2	roof disconnected from the wall by pottery		
P8-ls3	veranda roof disconnected from the wall		
P9 EARTHQUAKES **Thin and stiff walls**			
P9-ls1	fitting wall types		
P9-ls2	structure flexibility		
P10 INSTABILITY OF FILLING WALLS BETWEEN CONCRETE PILLARS			
P10-ls1			
P11 CLIMAT **Heat and humidity**			
P11-ls1	ventilation with tarpaulin partition wall		
P11-ls2	ventilation with wooden partition wall		
P11-ls3	green roof		
P11-ls4	tile roof		
P11-ls5	ventilated roof		
P12 BAD COB CONSTRUCTION			
P12-ls1	site organisation		
P12-ls2	mud preparation - adding fiber against shrinckage		

P12-ls3	mud preparation - mixing		
P12-ls4	mud transport		
P12-ls5	wall construction		
P12-ls6	cob ramming		
P12-ls7	protection against fast drying and shrinckage		
P12-ls8	protection against shrinckage		
P12-ls9	cob cutting		
P13 WALLS DAMAGED BY RAIN			
P13-ls1	frontage covering by plastic sheet		
P13-ls2	double green wall		
P13-ls3	iron sheet frontage		
P13-ls4	overhanging roof		
P14 GROUND HUMIDITY **Wall base damaged**			
P14-ls1	raising walls disconnected from the ground		
P14-ls2	zinc wall base treatment		
P14-ls3	bamboo mat treatment		
P14-ls4	wall panels in walling structure		
P14-ls5	iron sheets laid on wood		
P14-ls6	mix wall : bamboo mat on zinc basement		
P14-ls7	earth basement under bamboo mat		
P14-ls8	fired bricks basement under bamboo mat		
P14-ls9	stone basement under cob wall		
P14-ls10	fired bricks basement under zinc wall		
P15 STRONG WINDS **Roof : cover wrenching**			
P15-ls1	green roof		
P15-ls2	tile roof		

P15-ls3	cover fastening with plant vines		
P15-ls4	eaves protection with an enveloping plastic sheet		
P15-ls5	cover fastening with net		
P15-ls6	cover fastening with bambous		
P15-ls7	cover fastening with net + bambous		
P14-ls8	proper iron sheet fixing		
P14-ls9	graven barge board		
P16 STRONG WINDS **Roof wrenching**			
P16-ls1	roof anchorings in the ground	P16-is1	light roof anchorings in the wall with protection of the top of the wall
P16-ls2	roof anchorings in the ground by tyres		
P16-ls3	roof anchorings on surrounding trees		
P16-ls4	roof anchorings in the ground by small stakes		
P16-ls5	light roof anchorings in the wall		
P16-ls6	light roof anchorings in the wall by fired bricks		
P16-ls7	wooden roof anchorings in the wall		
P17 SALTY ENVIRONMENT			
P17-ls1	green roof choice		
P17-ls2	tile roof choice		
P17-ls3	rustproof treatment for iron sheets		
P18 THEFT			
P18-ls1	bars at the windows		
P19 LANDSLIDES			
P19-ls1	protection against house sliding		

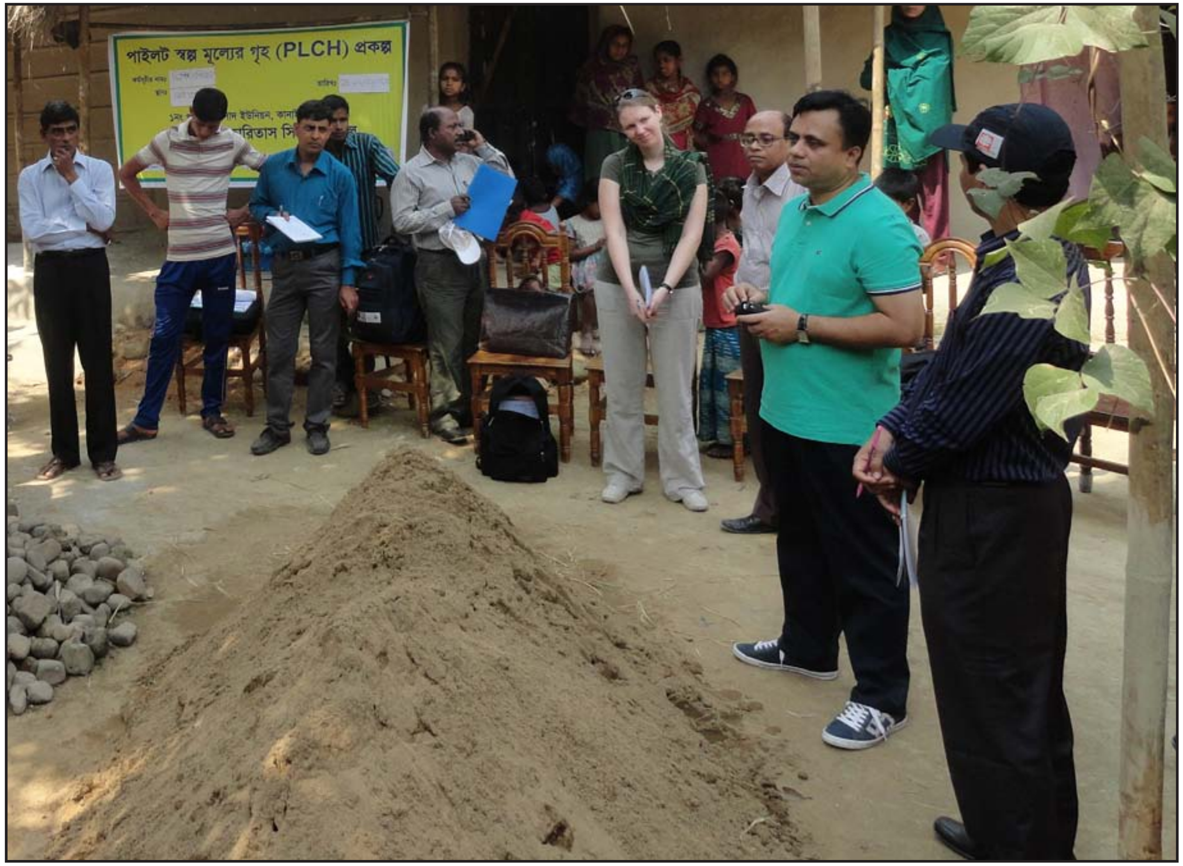
SUMMARY

Maintenance

P1 HOUSE DETERIORATION ALONG THE TIME **Walls deterioration due to the use**			
P1-ls1	refurbishment of earth plaster		
P2 HOUSE DETERIORATION ALONG THE TIME **Platform erosion**			
P2-ls1	recurrent platform protection with earth plaster		
P3 HOUSE DETERIORATION ALONG THE TIME **Rusted iron sheets**			
P3-ls1	rust protection in salty areas		

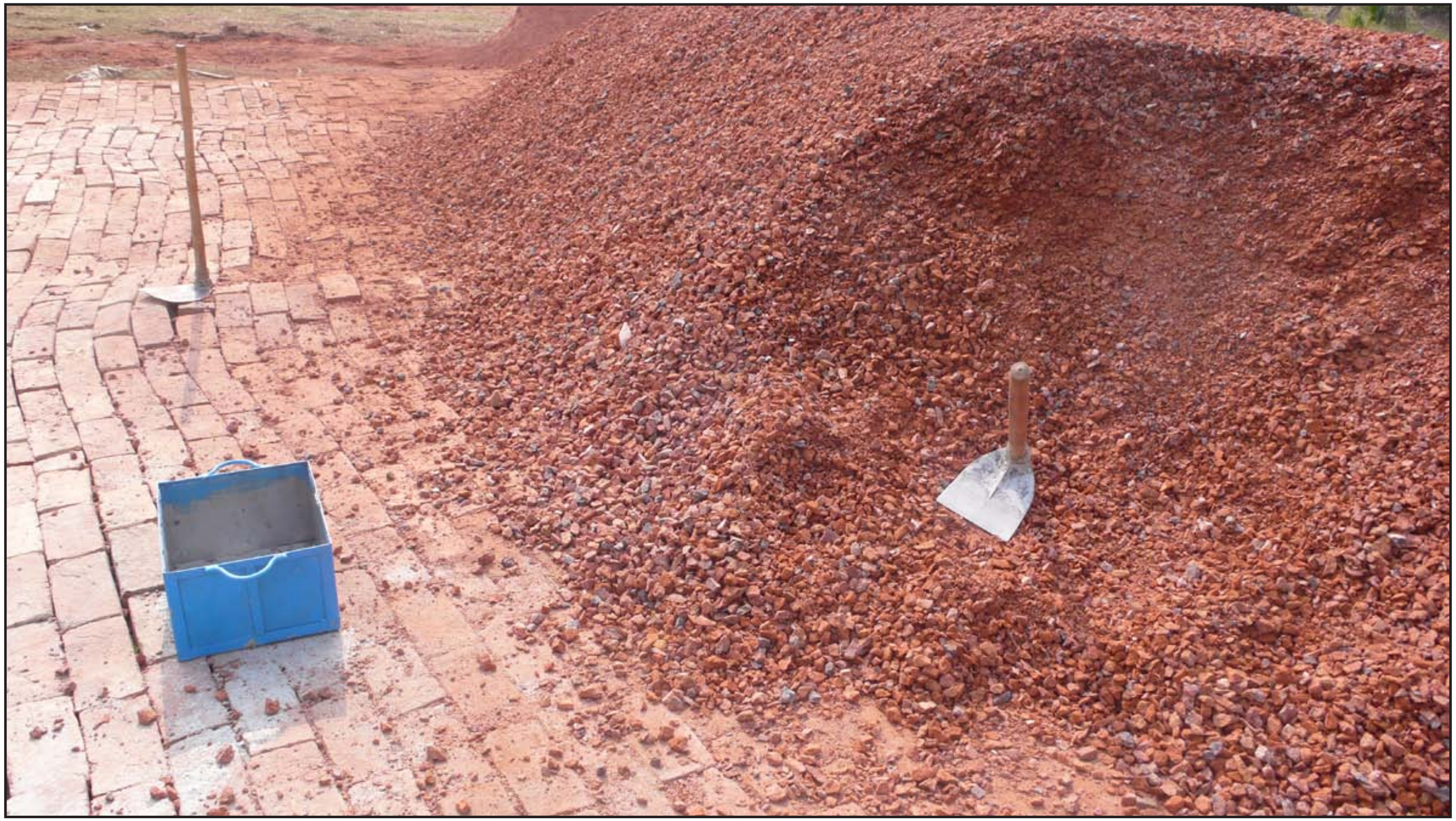
- Building materials available on site -

sand



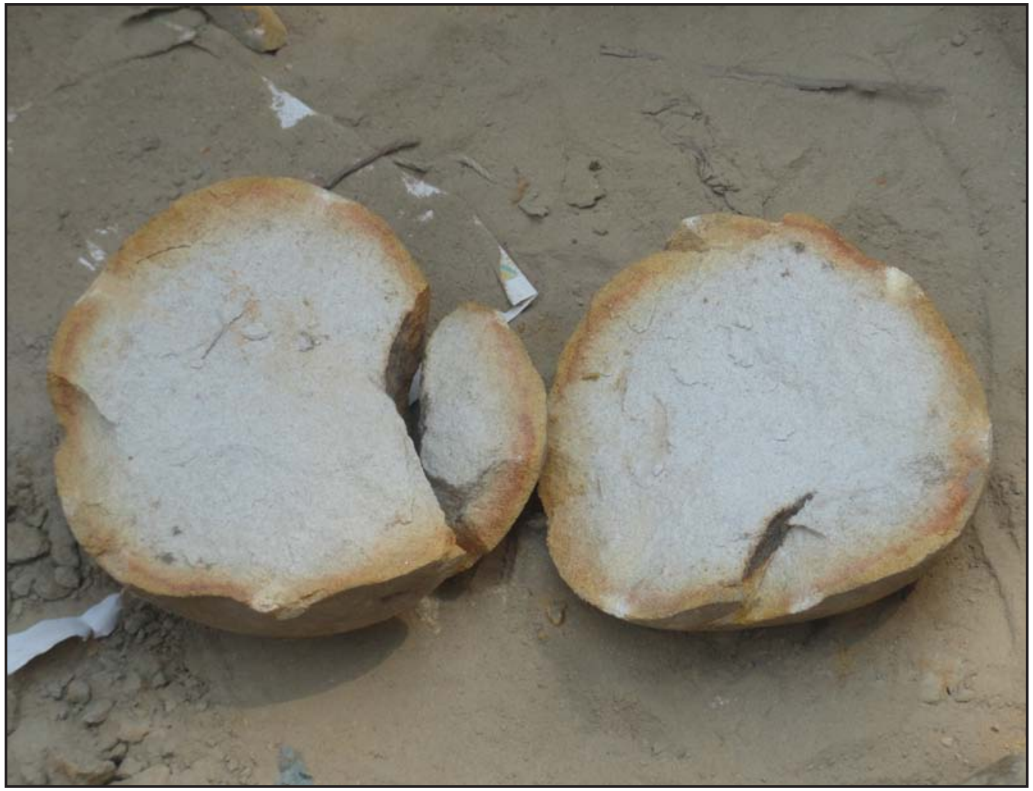
- Building materials available on site -

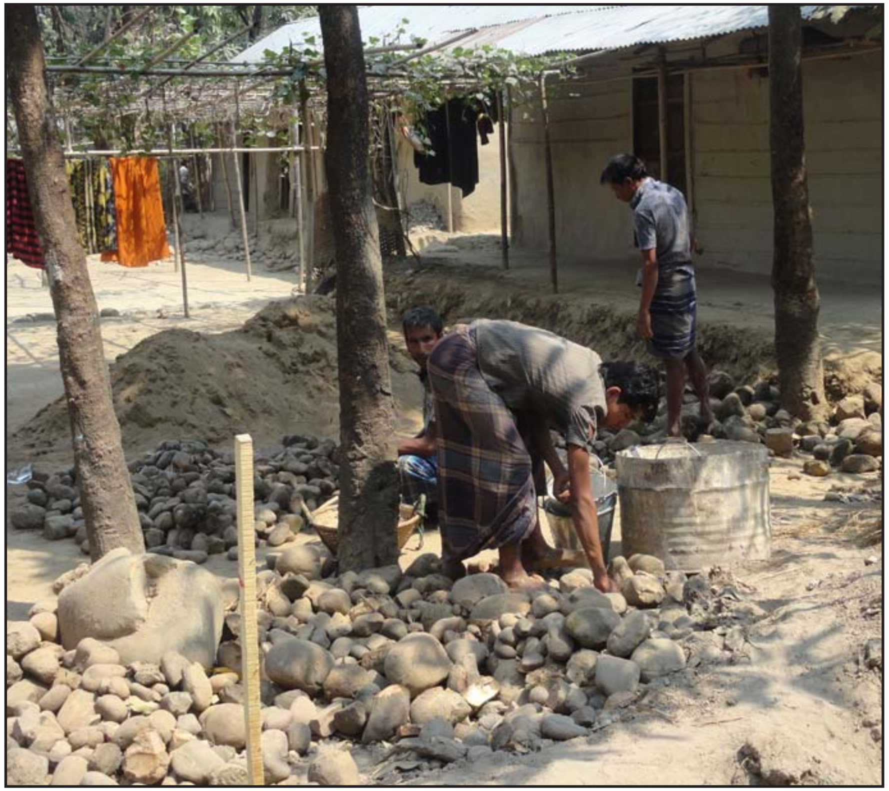
pebbles, gravels



- Building materials available on site -

stones, shingles





- Building materials available on site -

earth

- Building materials available on site -

water

- Building materials available on site -

water

- Building materials available on site -

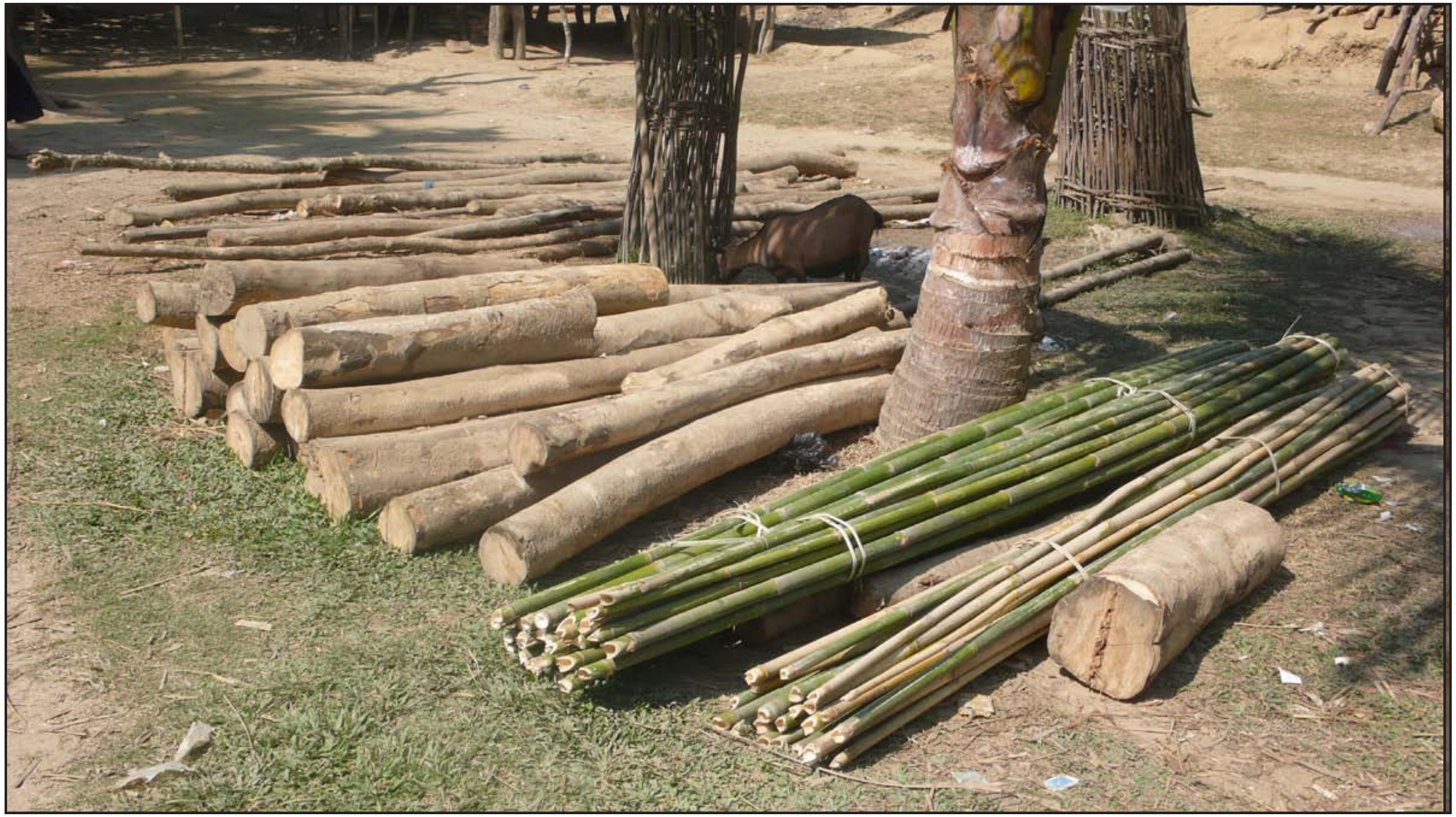
water retention and recovery

Rasjhahi

Sylhet

- Building materials available on site -

wood, various plants

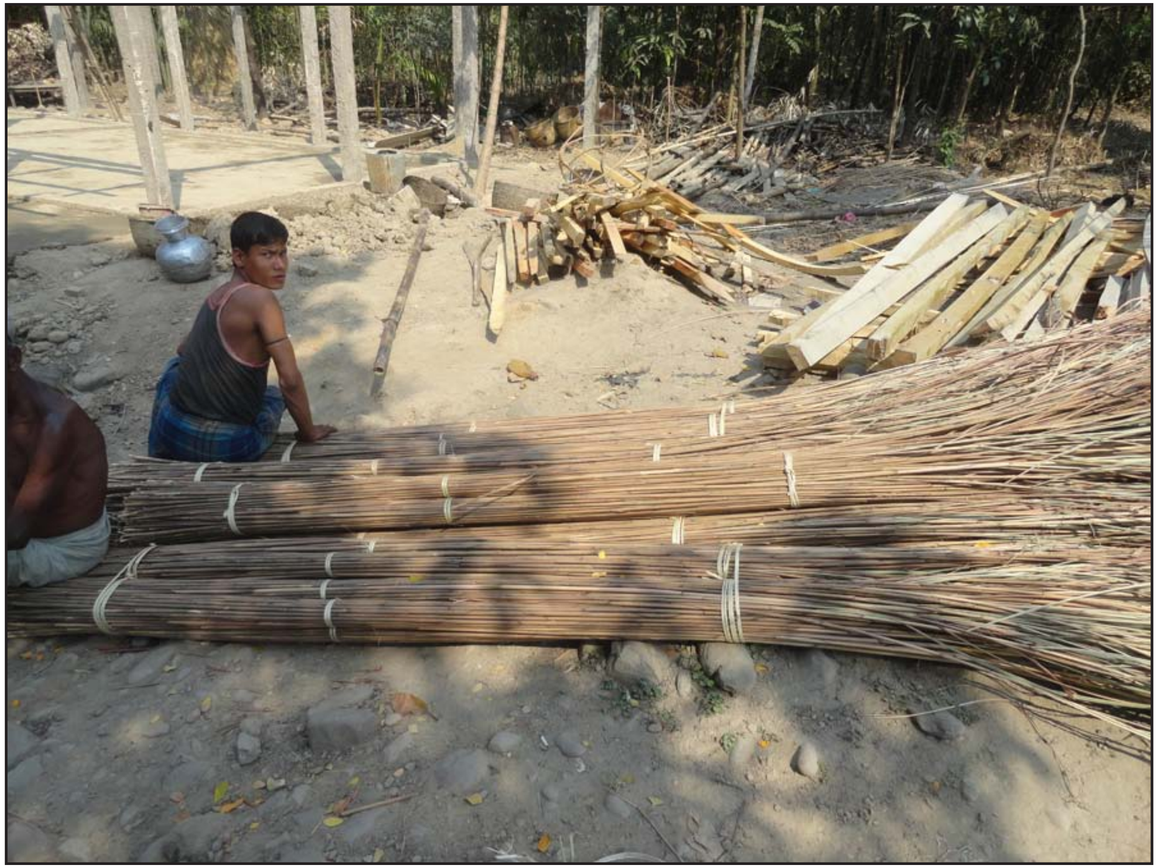


- Building materials available on site -

wood, various plants

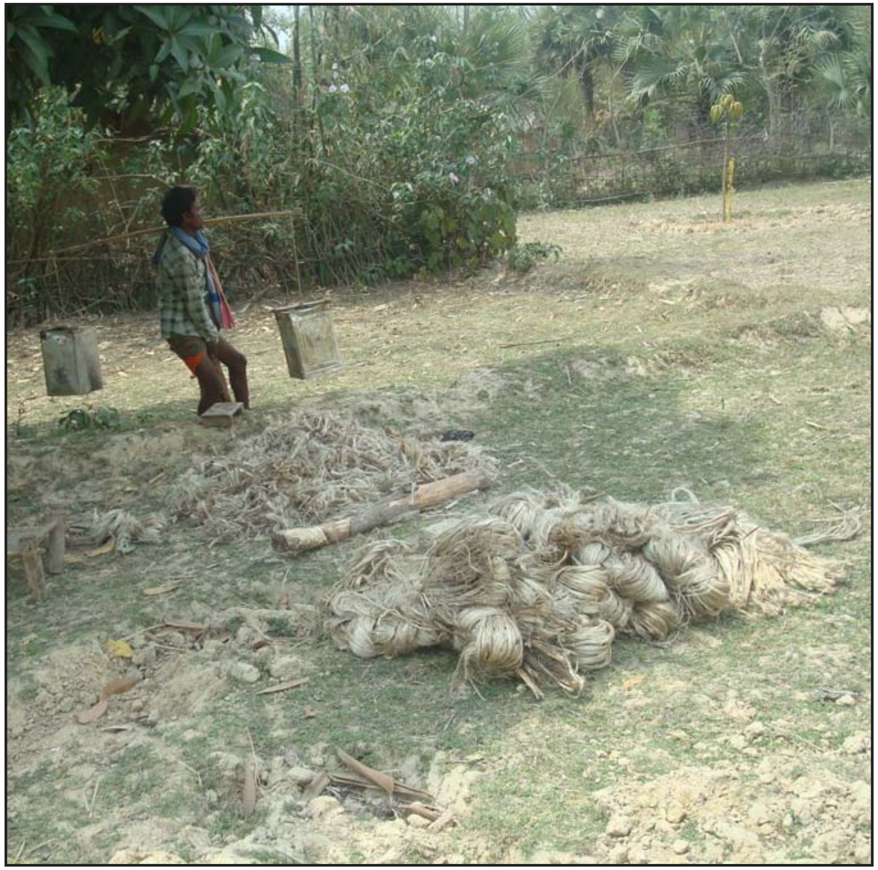
- Building materials available on site -

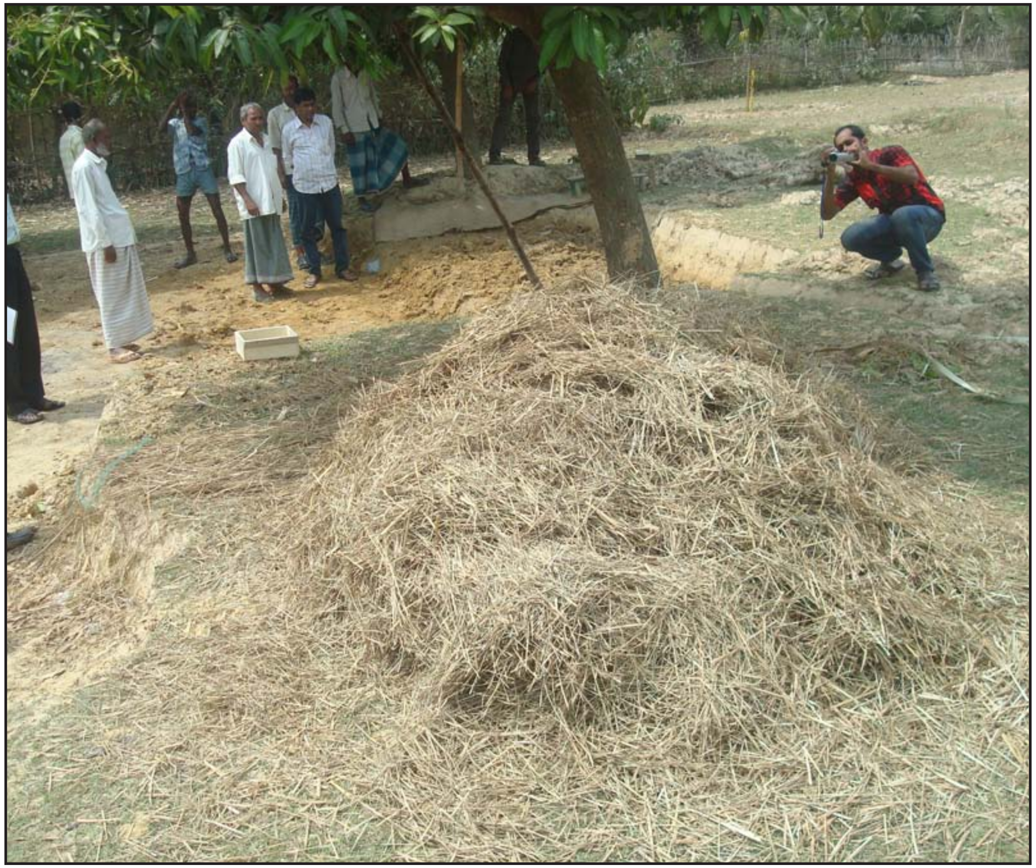
wood, various plants



- Building materials available on site -

fibres

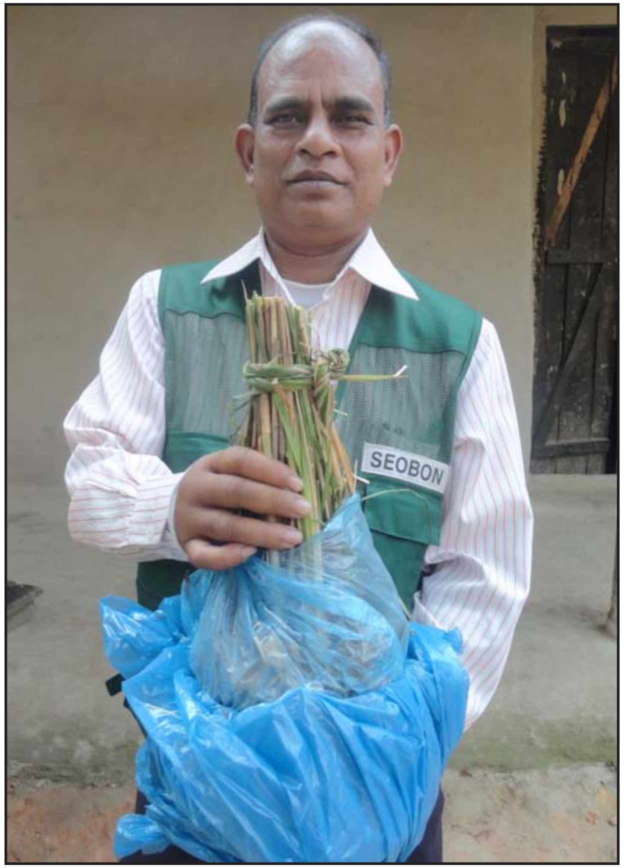


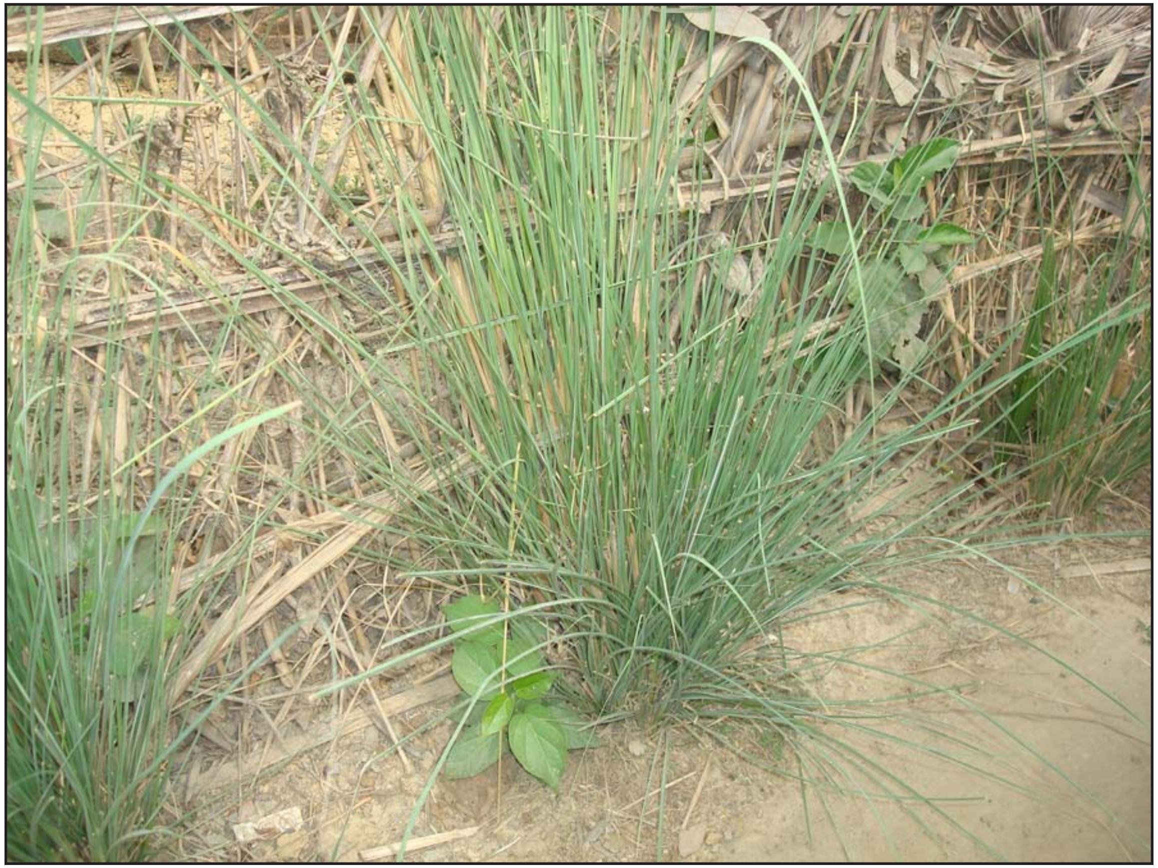


Sisal, straw, ...

- MBuilding materials available on site -

binders



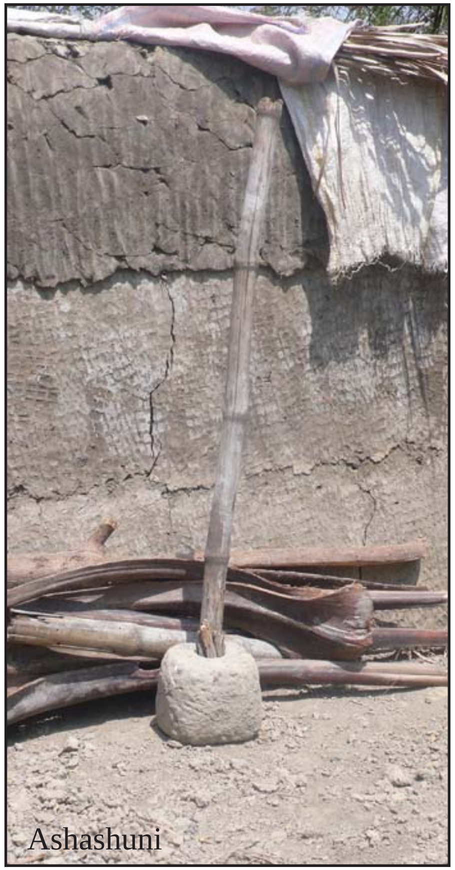


- VARIOUS TOOLS -

for earth construction

- VARIOUS TOOLS -

for cob



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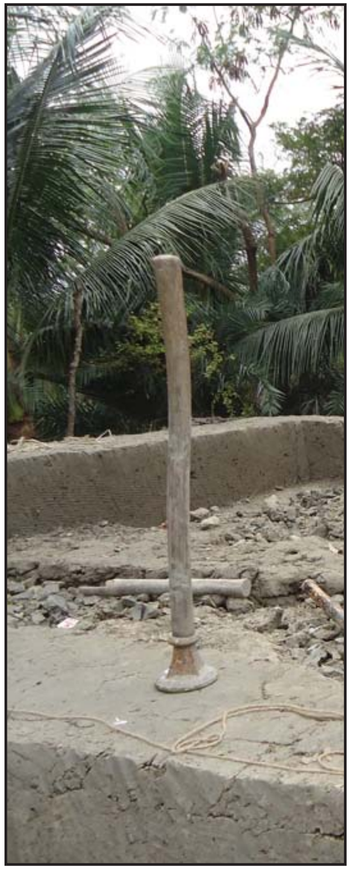
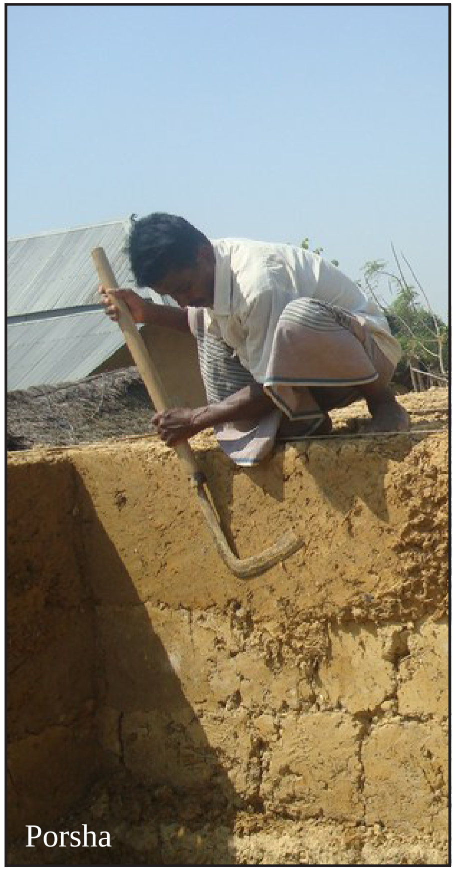
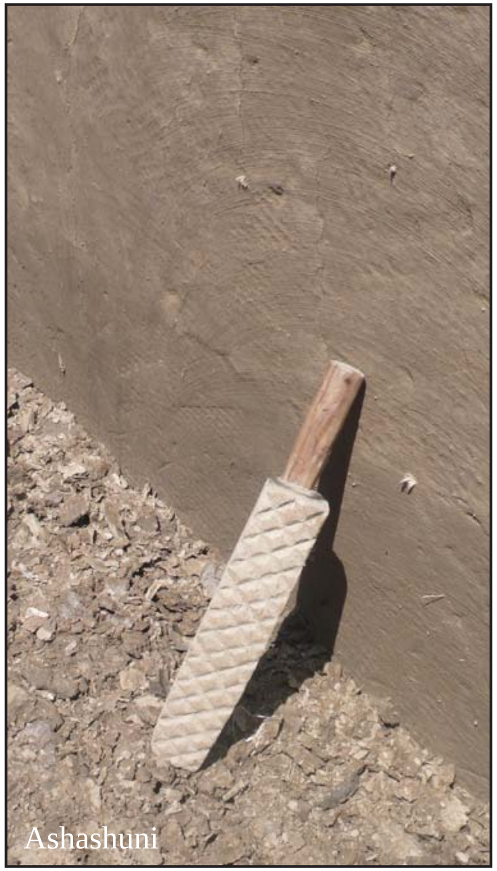




Porsha

- VARIOUS TOOLS -

for cob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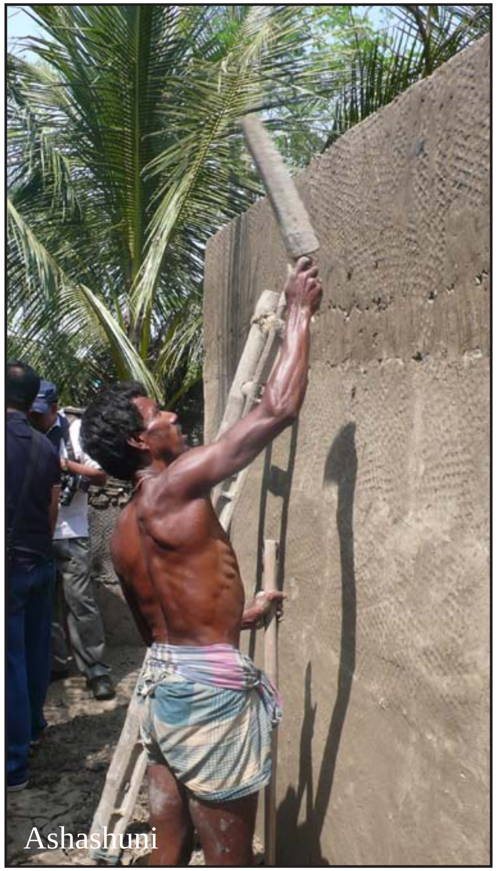
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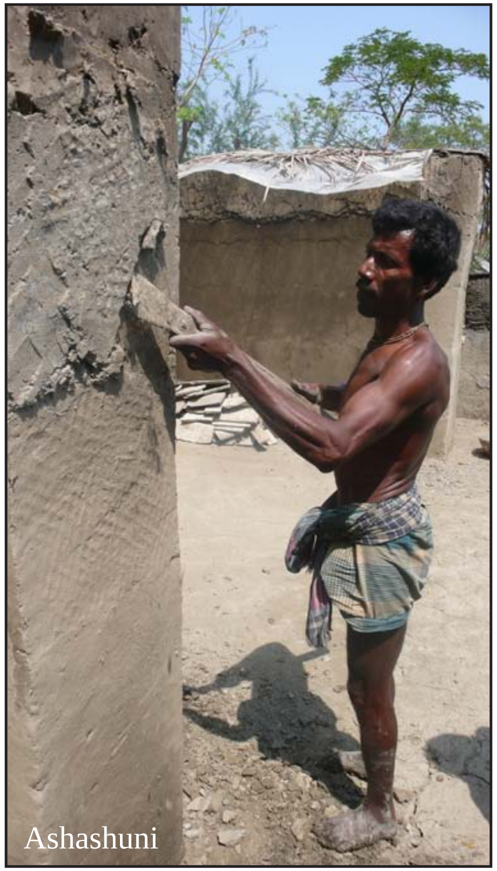
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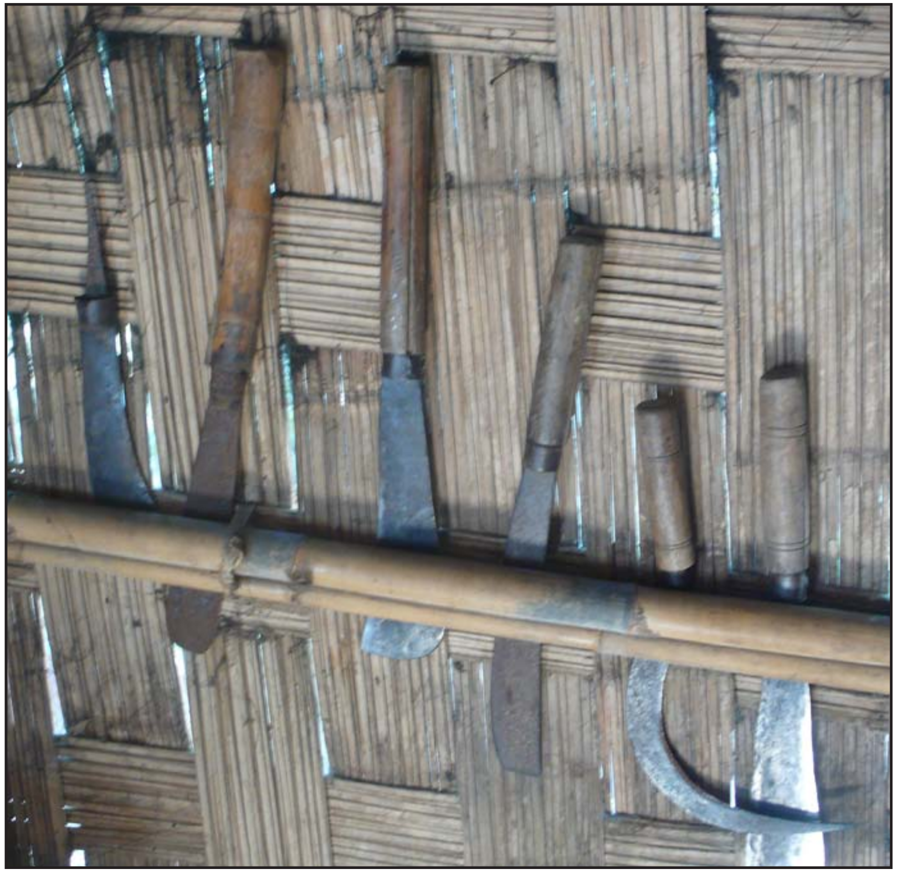
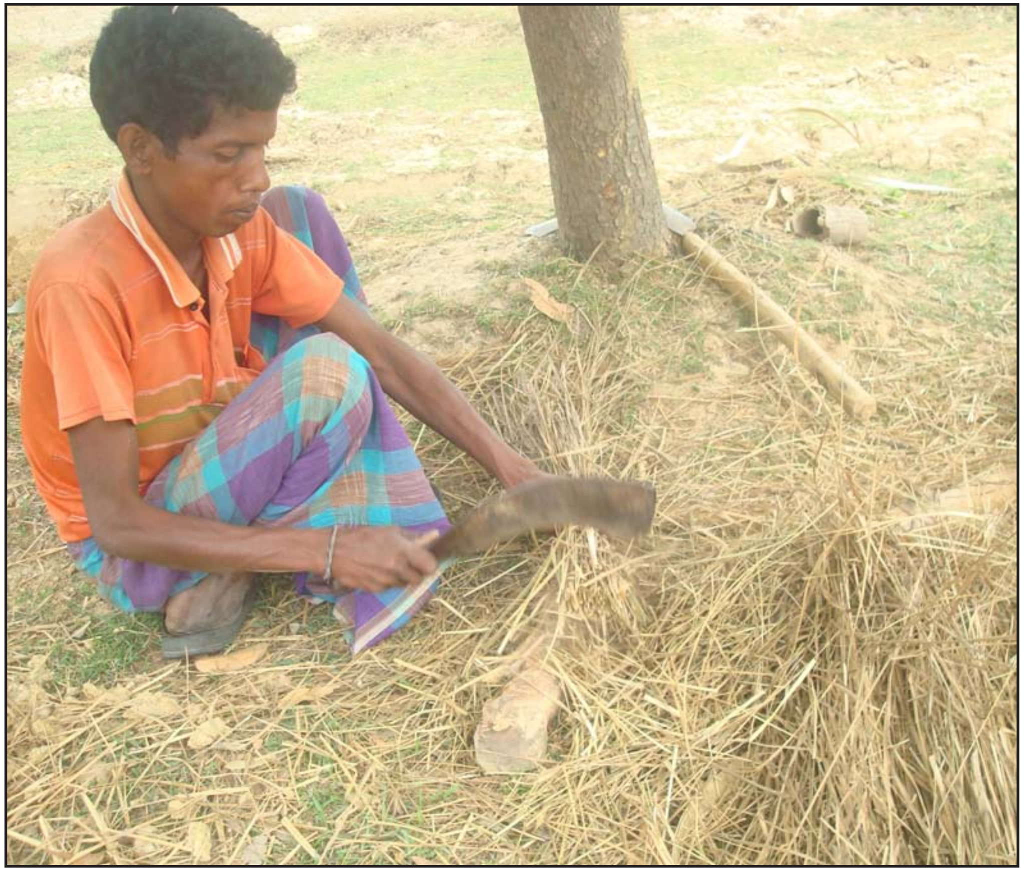
To compact the surface and to increase its resistance.

- VARIOUS TOOLS -

for fibres, small branches, ...

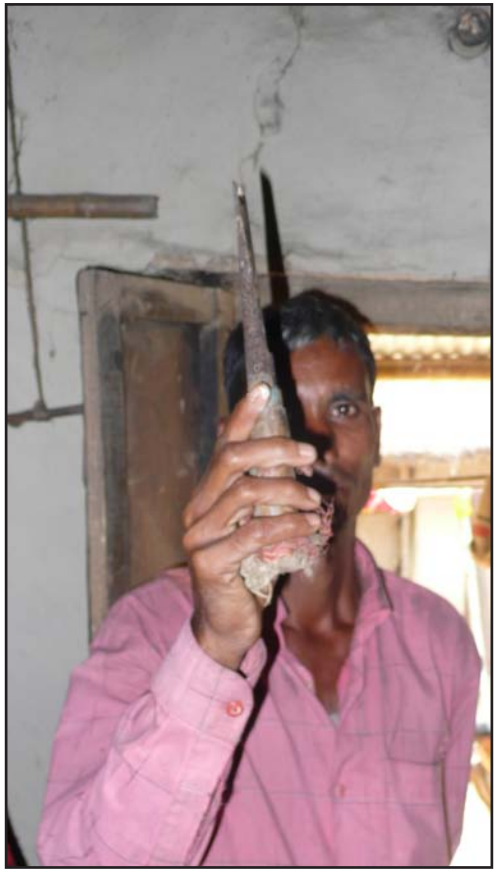




Sharp and cutting tools.

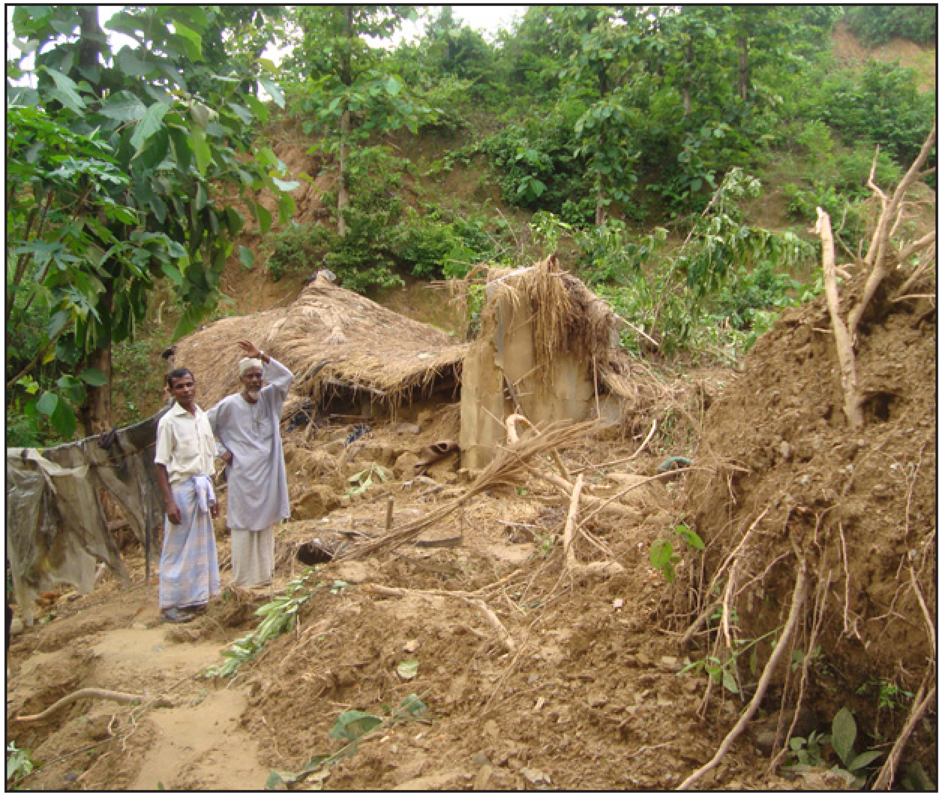
- VARIOUS TOOLS -

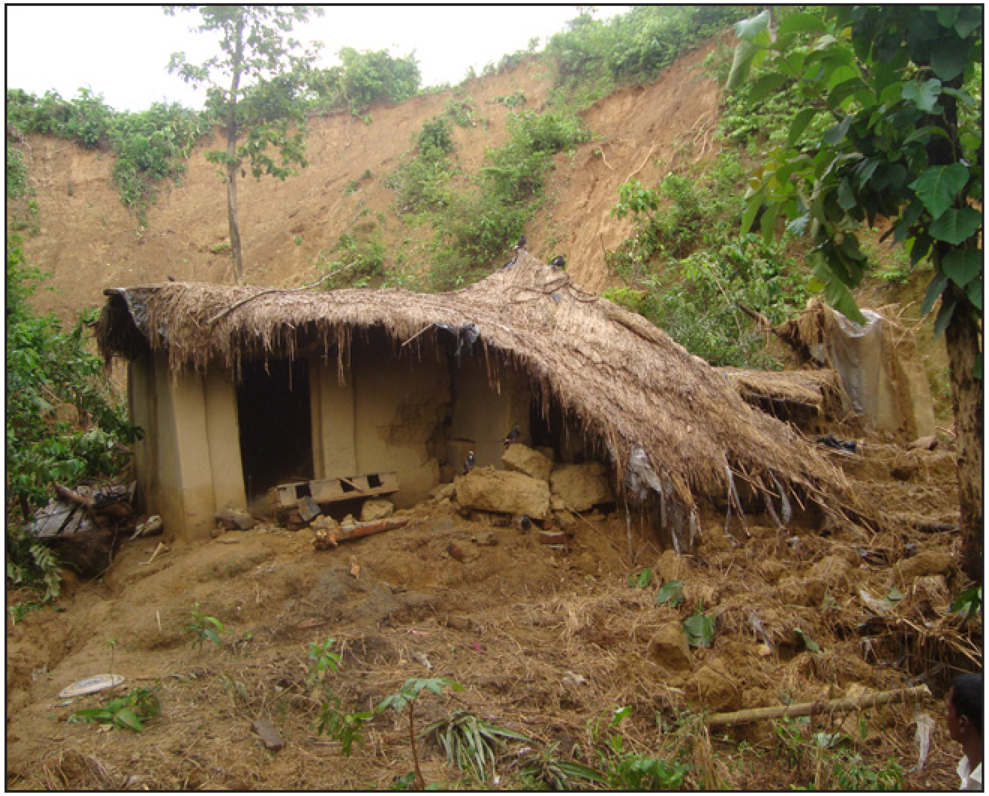
for wood



Wood driller.

- LANDSLIDES -

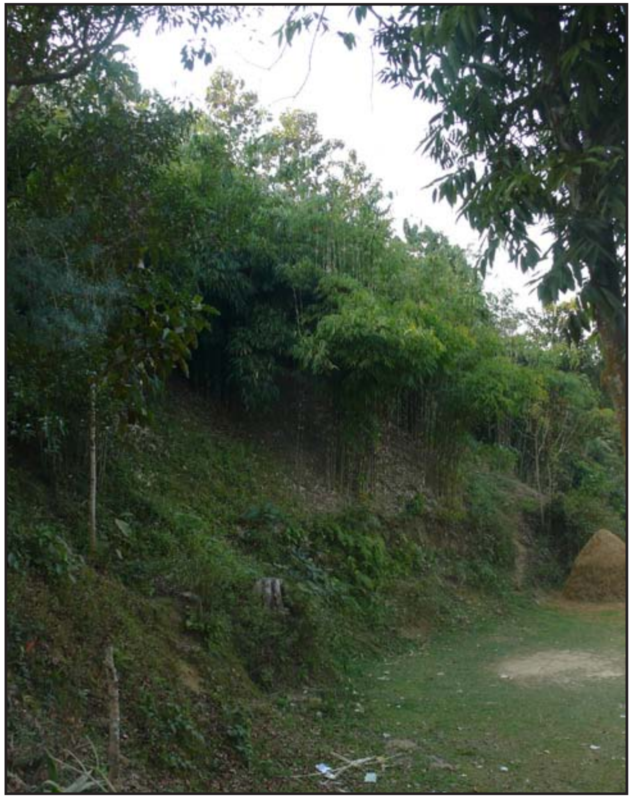


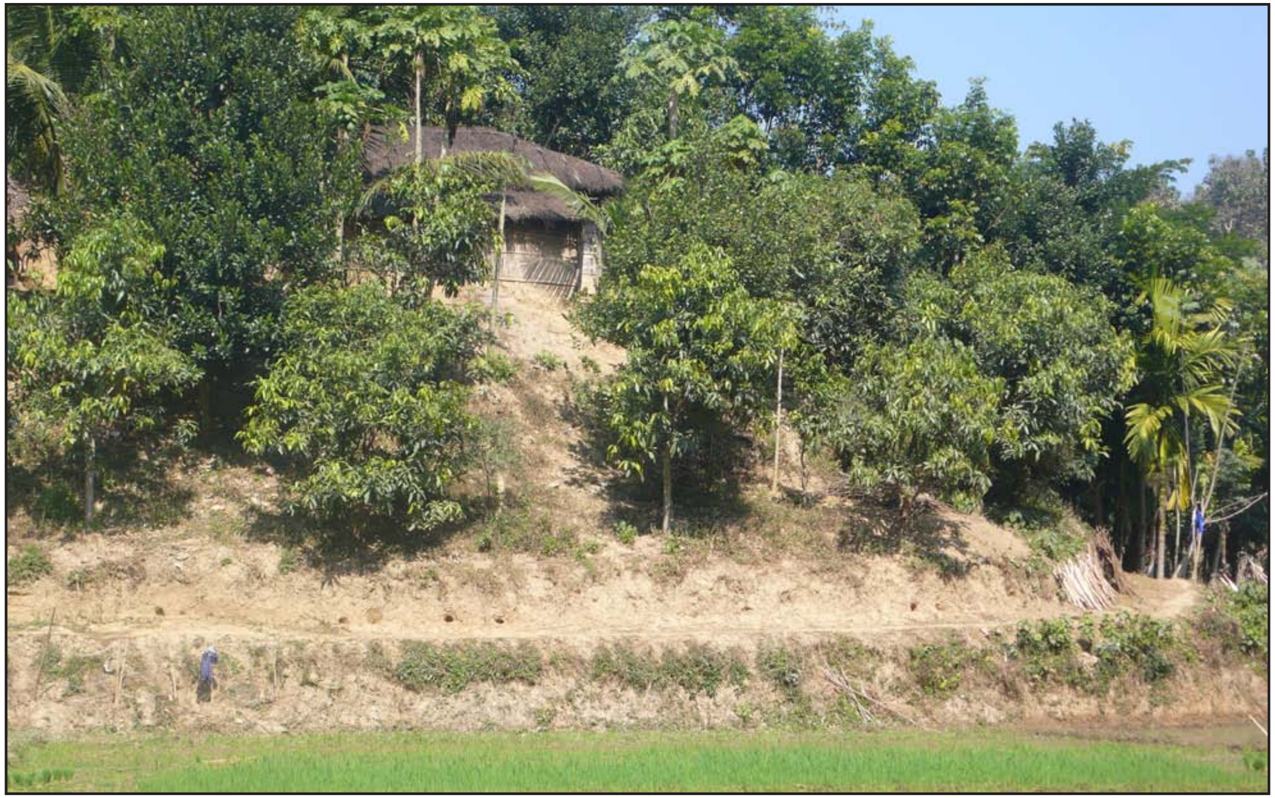


Highly sloped land which tends to slide down.

- Protection against landslides -

plantations

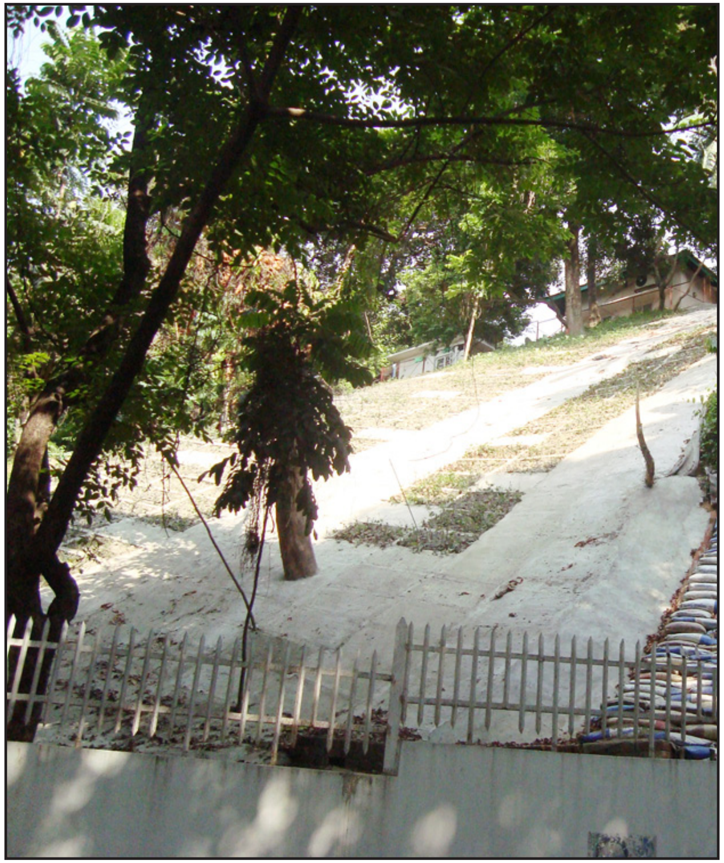




Plantation of bambous and other vegetable varieties to reinforce and reduce the erosion in sloped lands :
- Roots prevent water streaming damages by keeping the ground,
- branches and leaves reduce wind and rain effects on the ground.

- Protection against landslides -

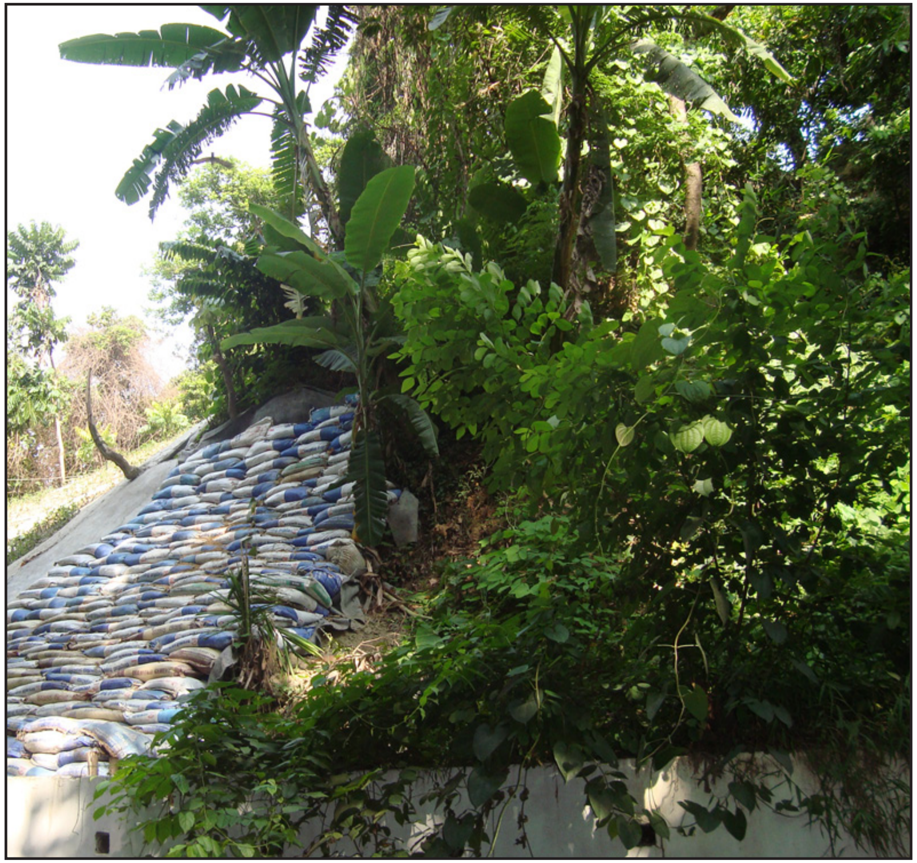
steep lands plantation systems



The main issue that occurs when seeding on a steep lands is that rains can wash away the soil. A geotextil bags system filled with soil and seeds will ensure to hold the soil, allowing the seeds to germinate and thus create the network of roots necessary for the long-term stability.

- Protection against landslides -

ground holding by coating



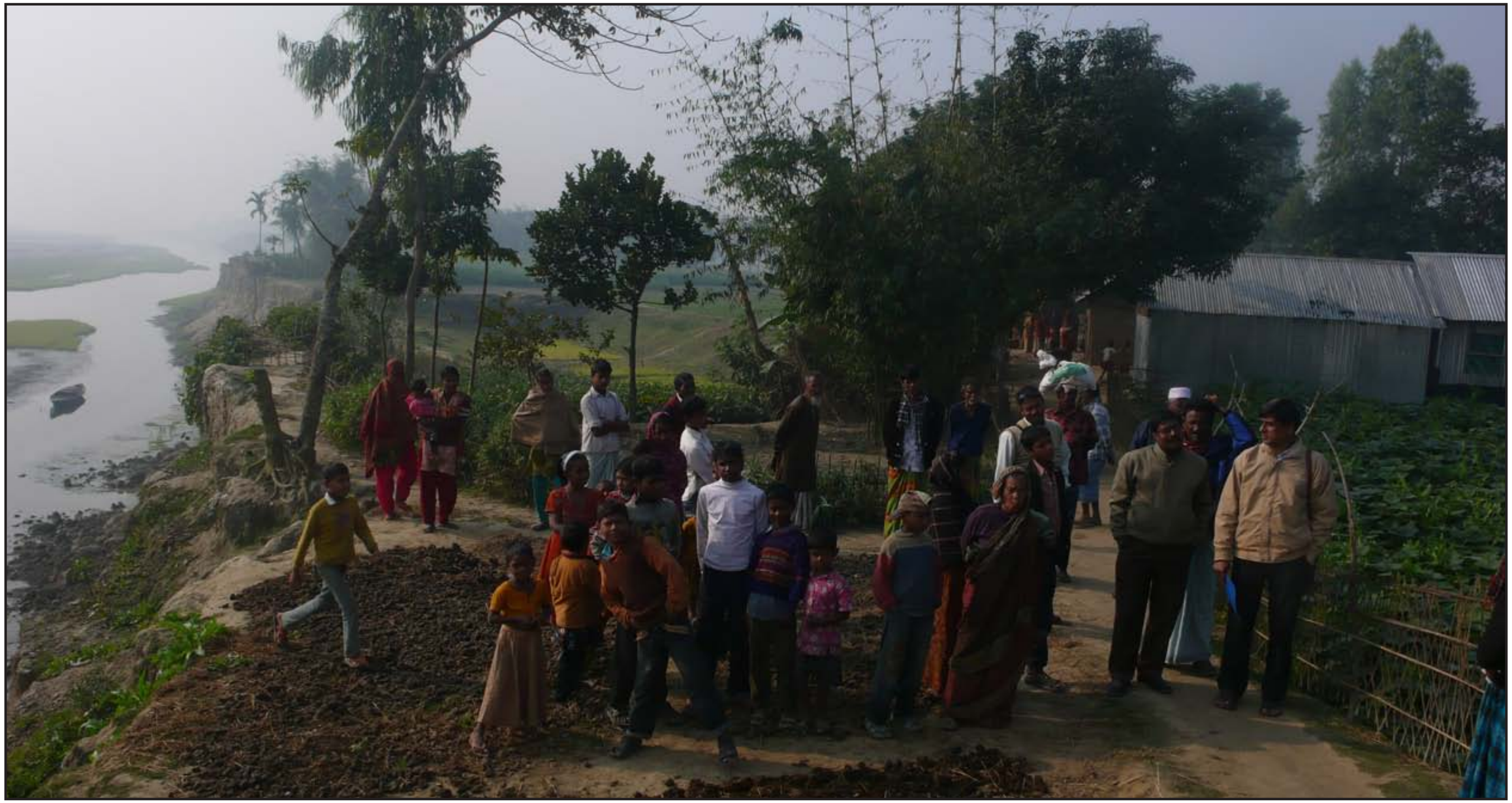
Coating can be made out in different way :

- sand bags, which can be easily replaced if damaged. Since it is a permeable system, water stagnation will be avoid.

☹

- FLOODS -

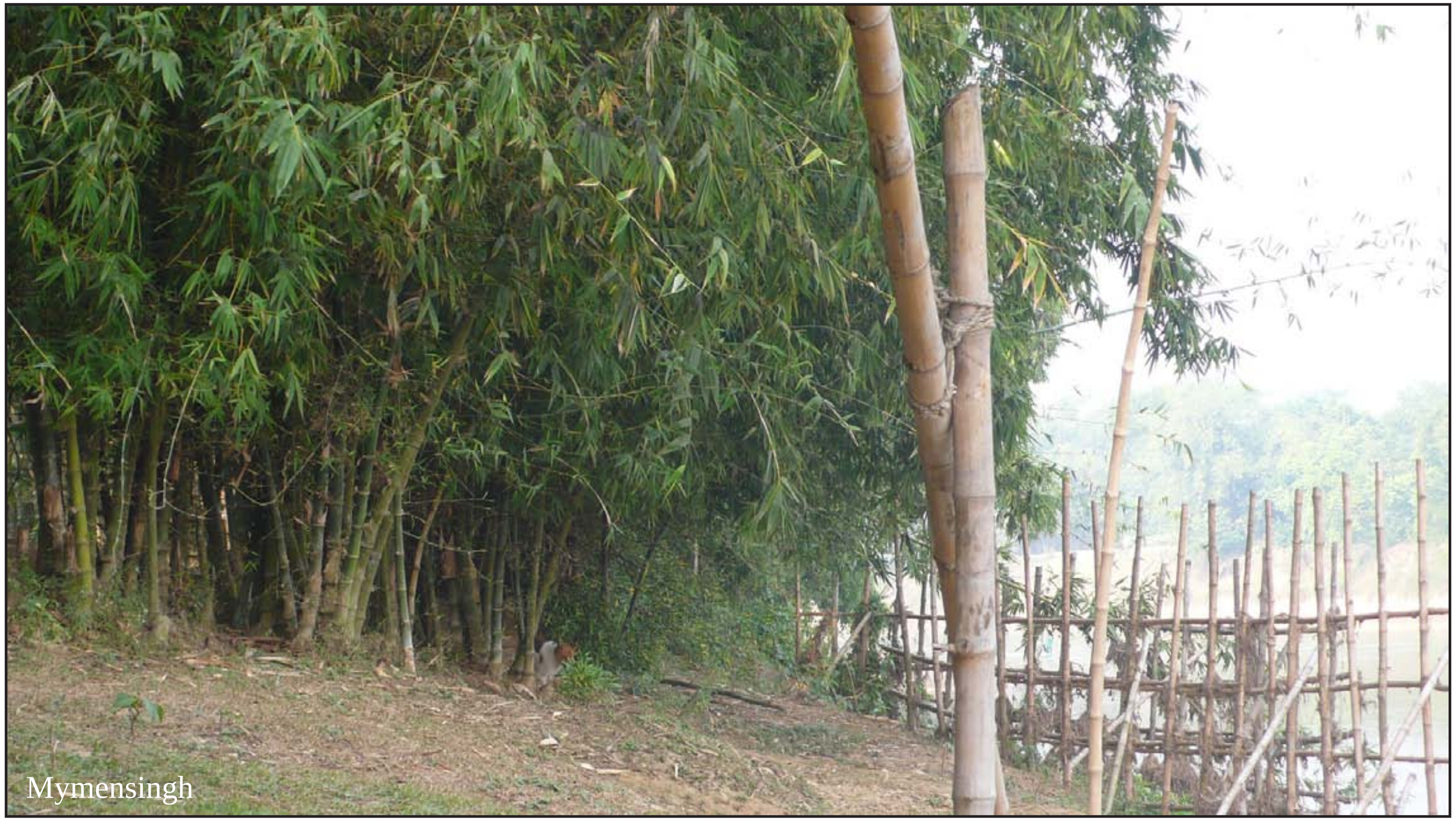
Riverbank erosion



River banks eroded by water ; the village is built right by the river with high risks for people and houses.

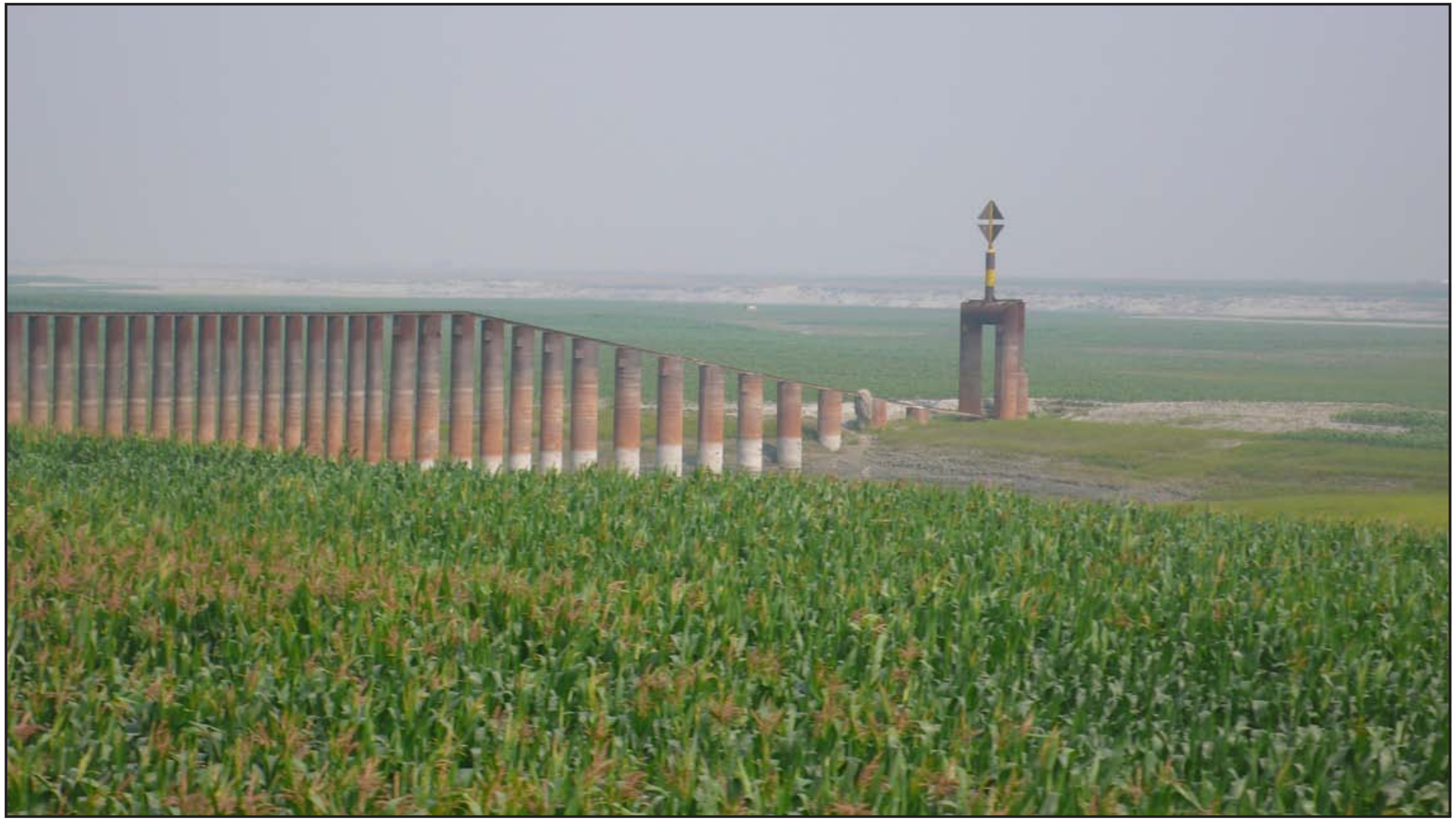
- Protection against floods -

wave breaker



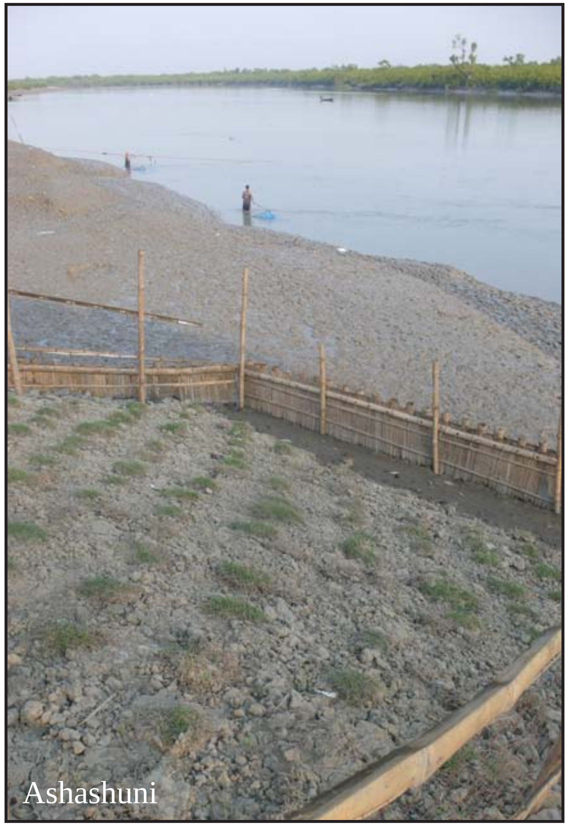
- Protection against floods -

wave breaker



- Protection against floods -

light embankment protection



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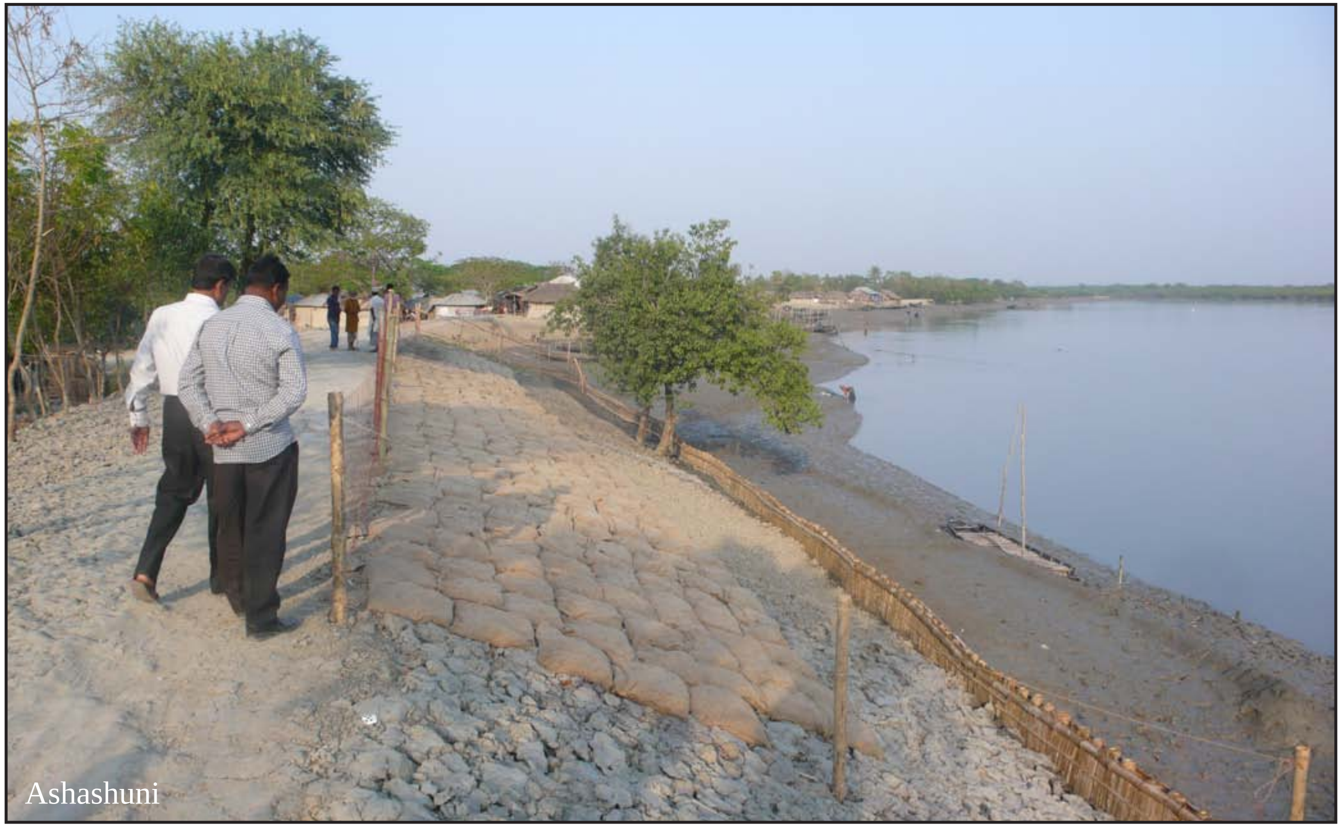

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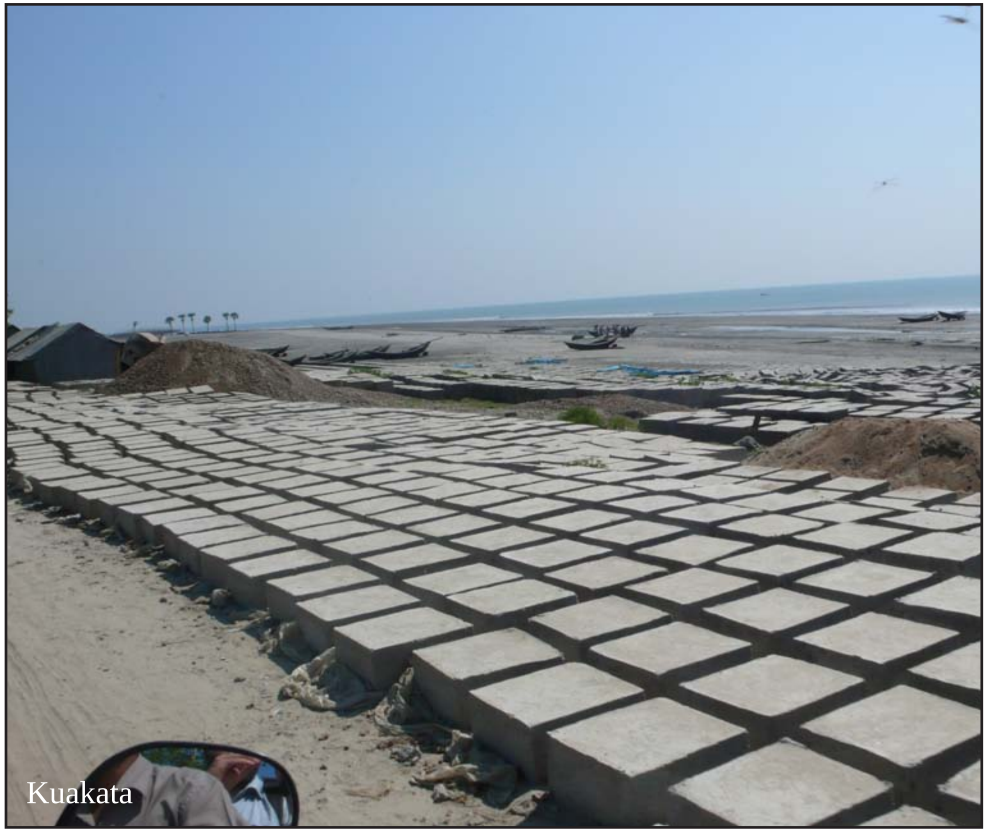
- Protection against floods -

embankment protection



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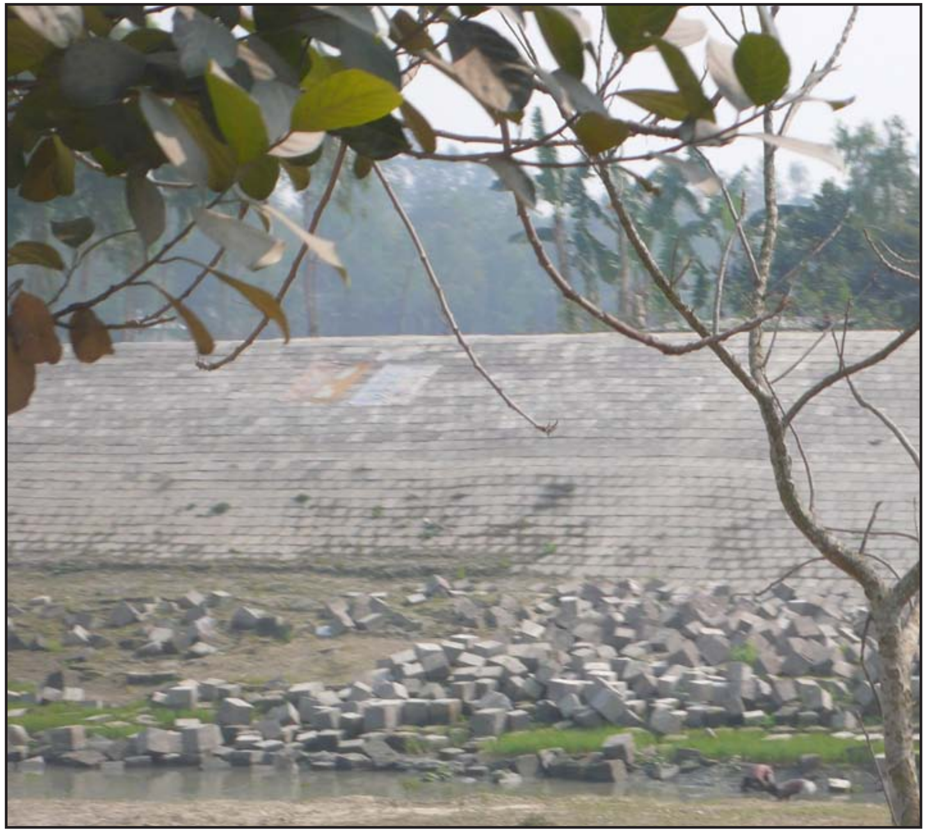
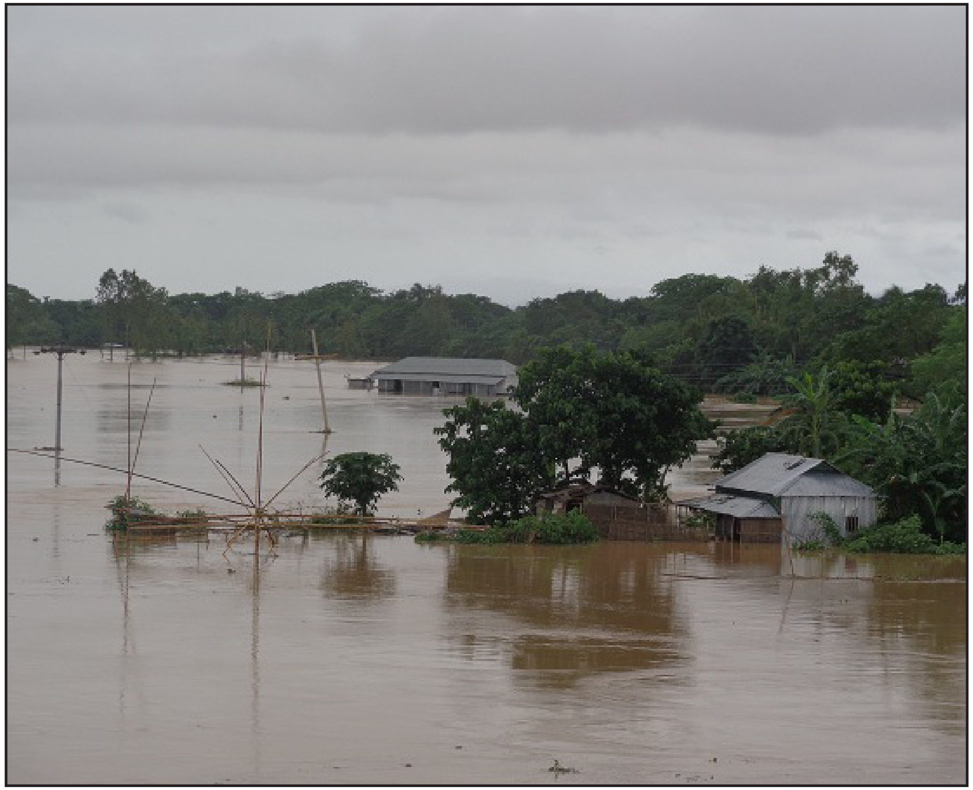
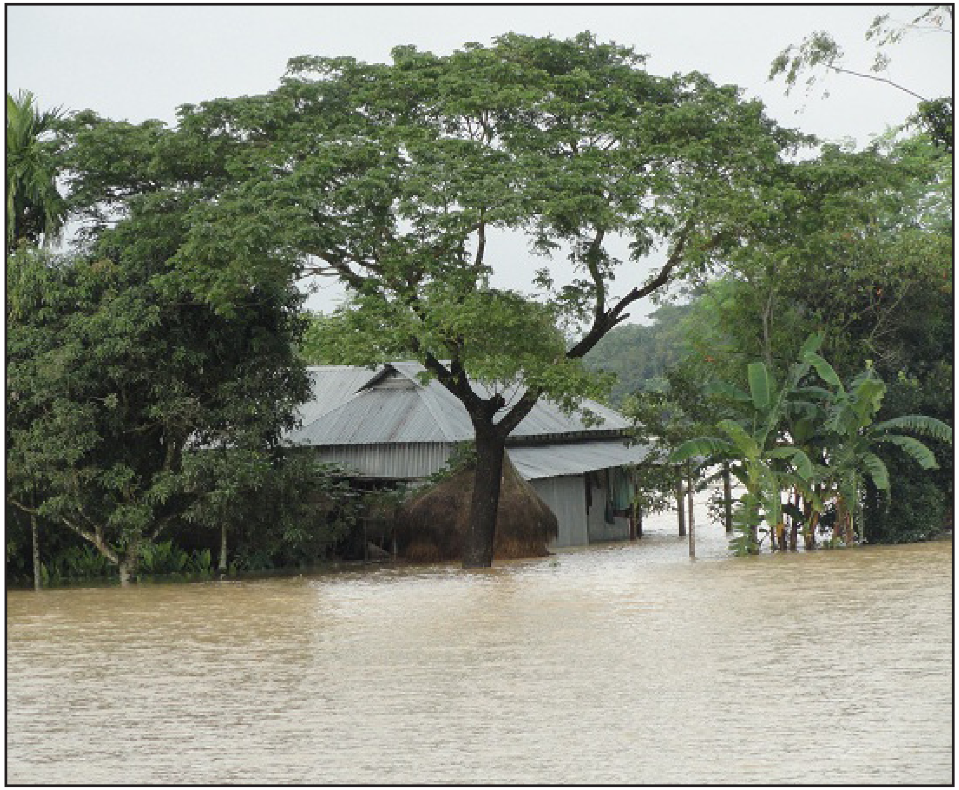


- FLOODS -

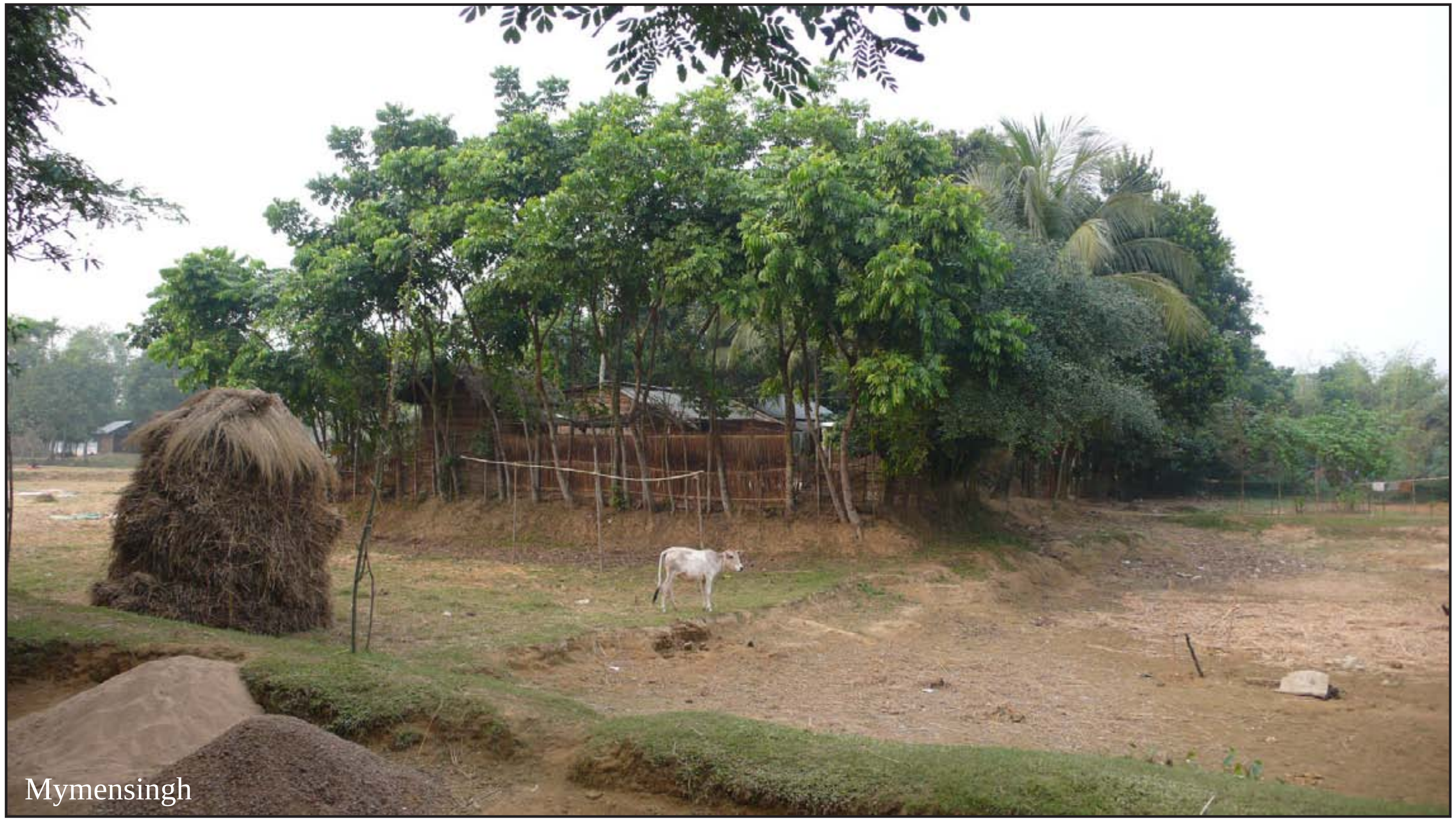
stagnant water





- Protection against floods -

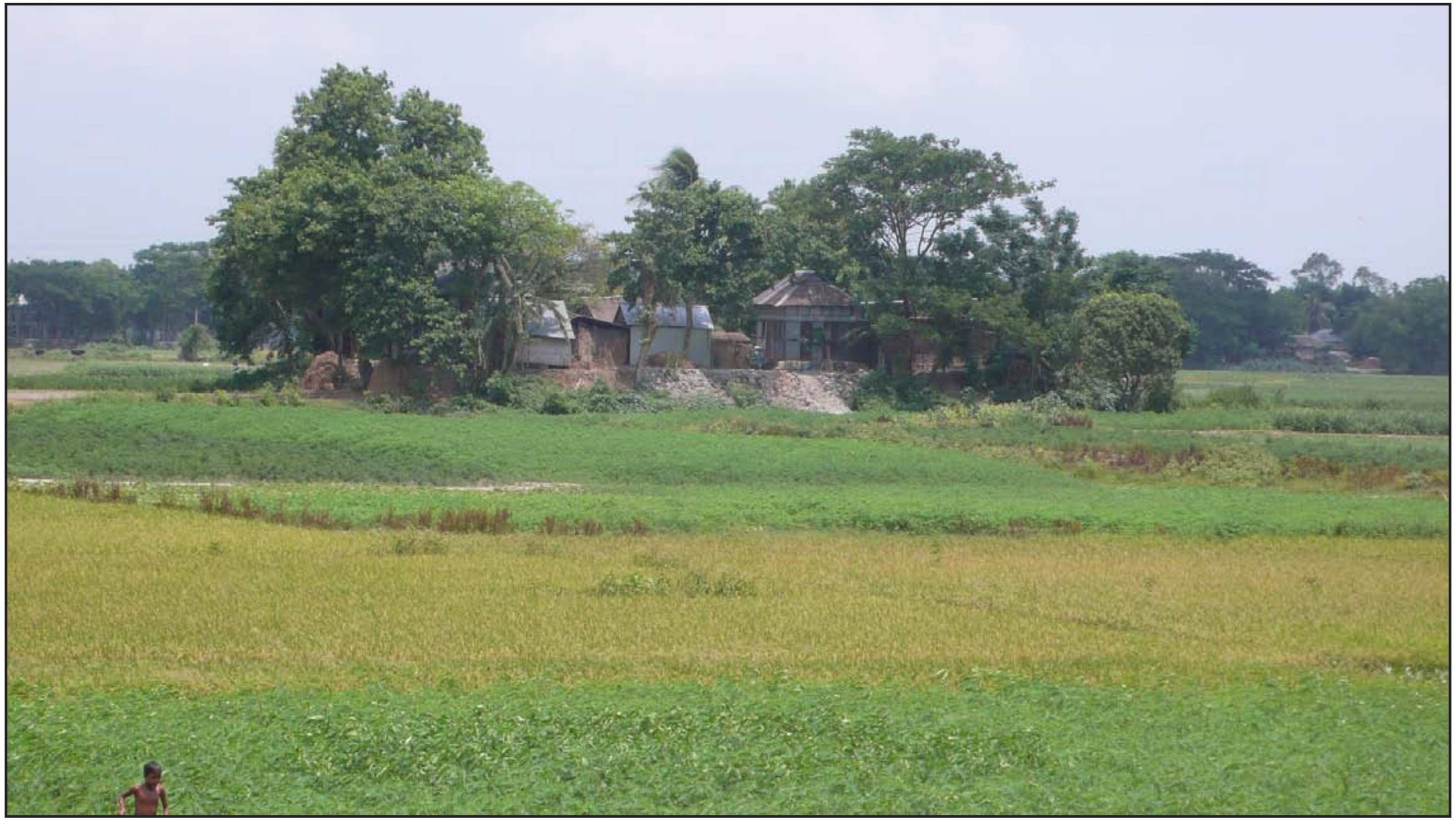
plinth



Implementation of a raised wide platform ; the house will be built on it, so as to be out of reach by water.

- Protection against floods -

plinth



Implementation of a raised wide platform ; the house will be built on it, so as to be out of reach by water.

- STRONG WINDS -

general deterioration of the buildings

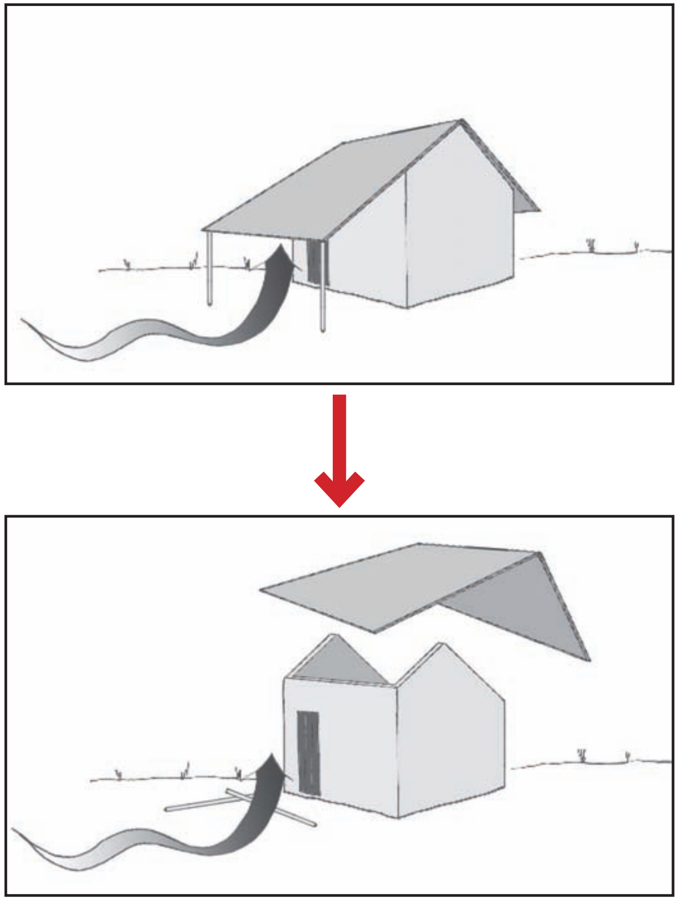
- Protection against strong winds -

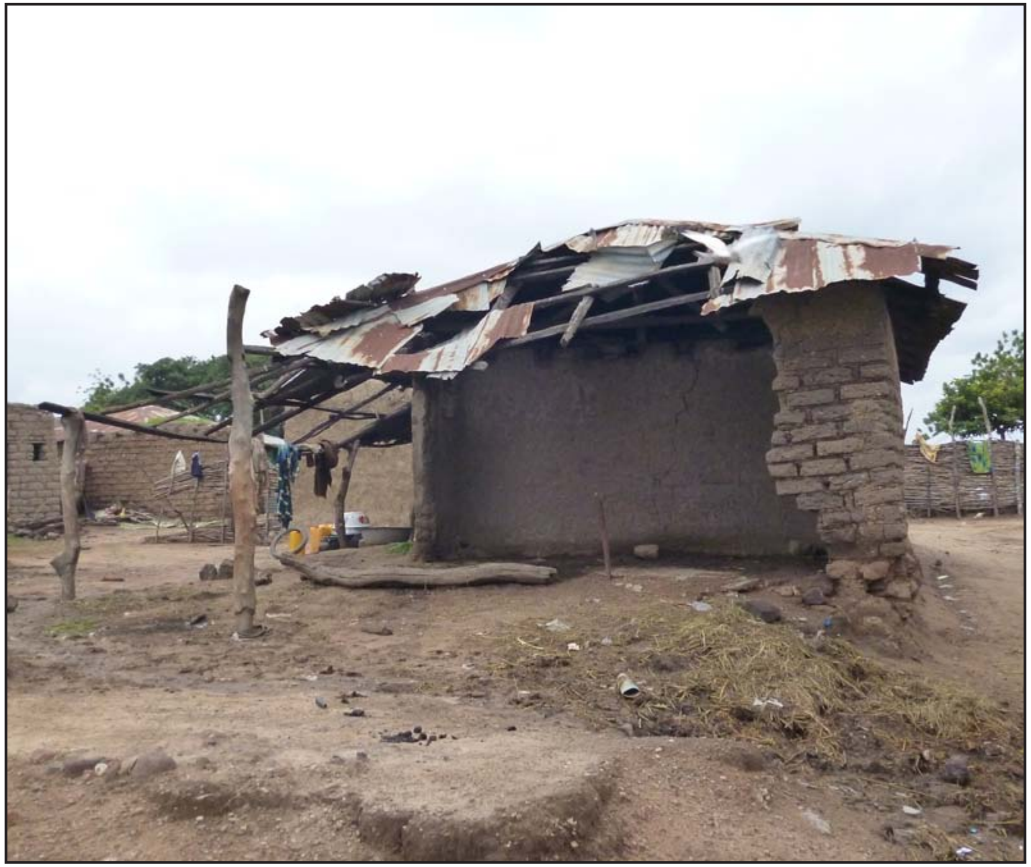
protection through trees

Trees should be planted all around the house in order to cut down the wind speed. High and rigid trees must be located far enough from the building to avoid danger in case of fall. Favour high vegetation further away and lower vegetation in the close environment of the house (type bambou, banana trees...).

- STRONG WINDS -

Complete roof wrenching : house + veranda

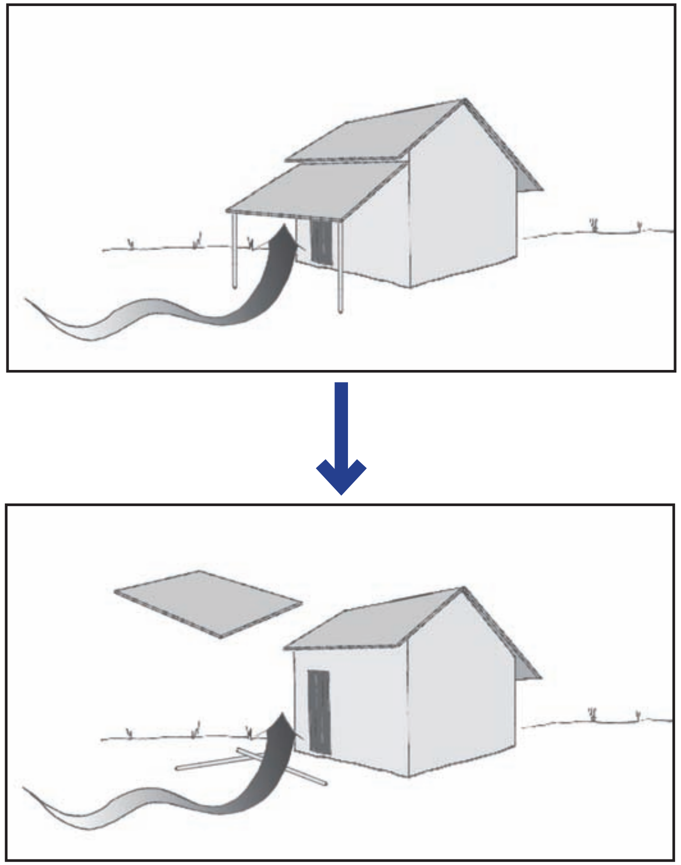


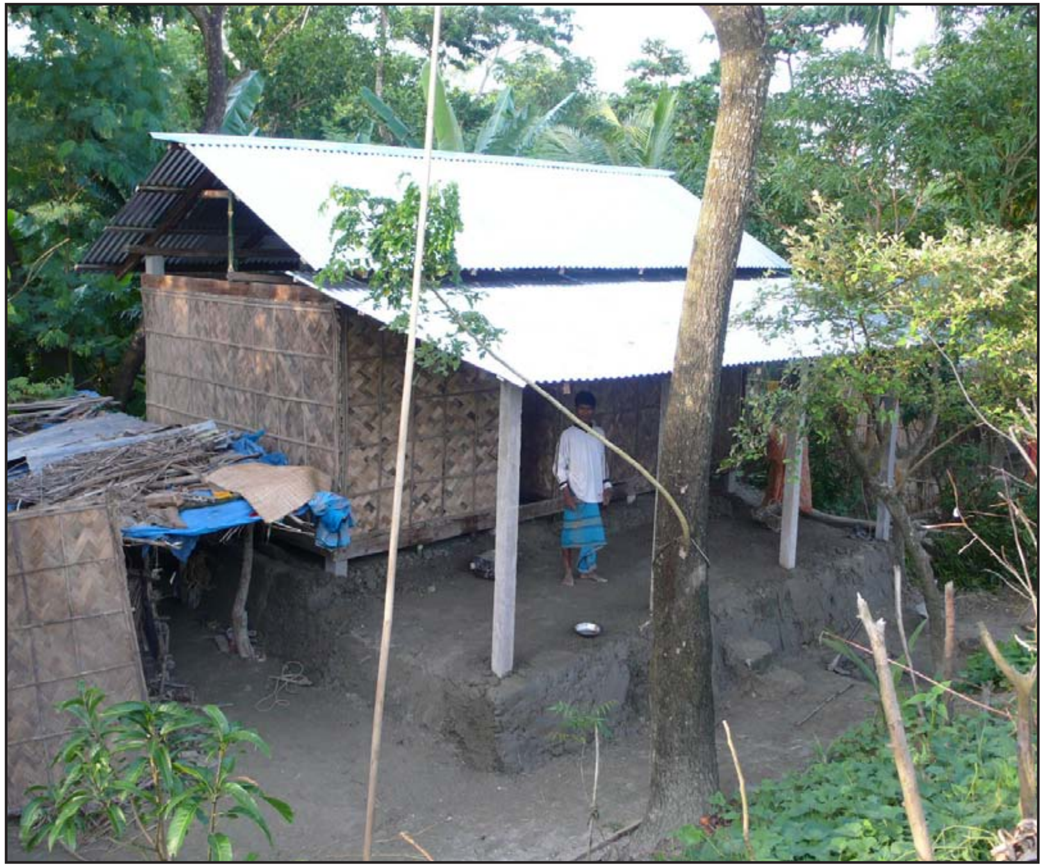


When the roof covers an open veranda, it allows the wind to easily blow into.
If only one roof covers both the building and the veranda, in case of strong winds all the covering will be pulled out.

- Protection against strong winds -

separate roofs



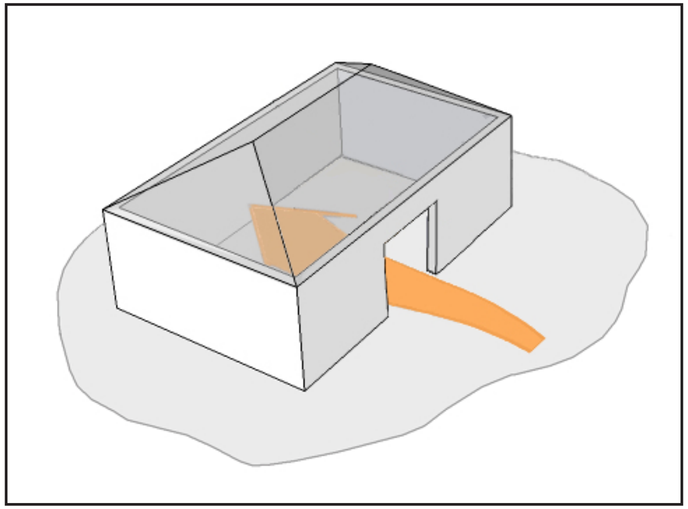


The roofs of the house and the veranda are disconnected from each other to avoid the lost of both of them in case of strong winds : only the veranda cover is supposed to bring the wind and to be snatched. On the contrary, the building roof would be preserved keeping the house inhabitable.

☹

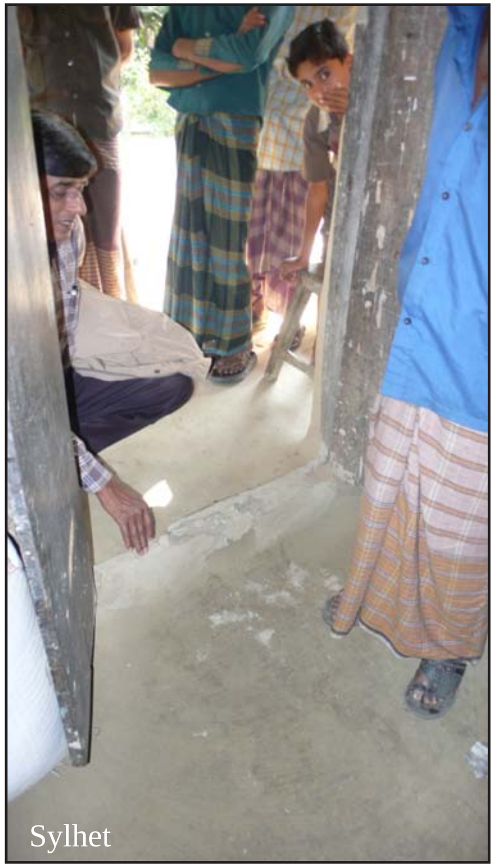
- FLOODS -

Water penetration through the door of the house



- Protection against floods -

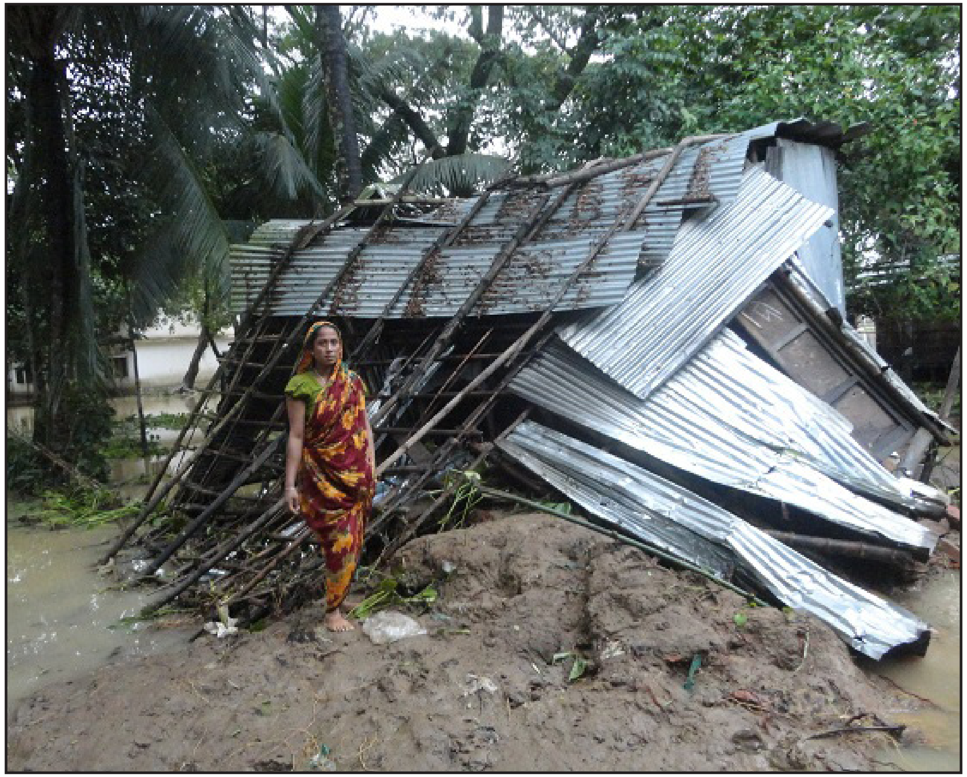
water barrier on the door sill

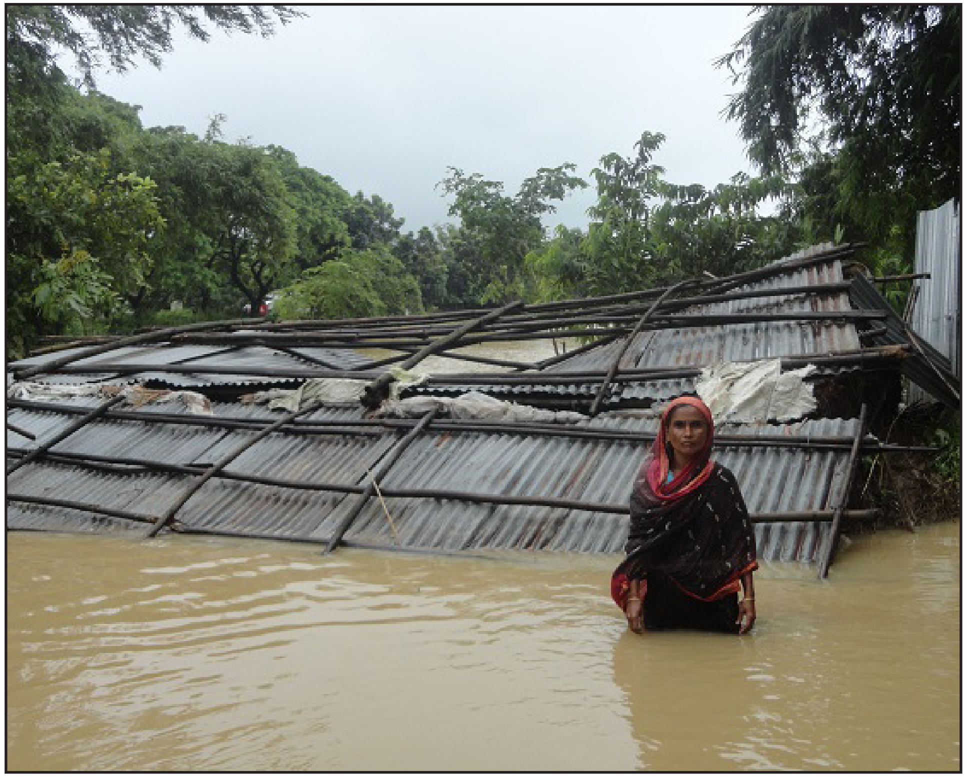


This barrier can be made out by different materials : wood board, small masonry works, ...

- RECURRENT FLOODS -

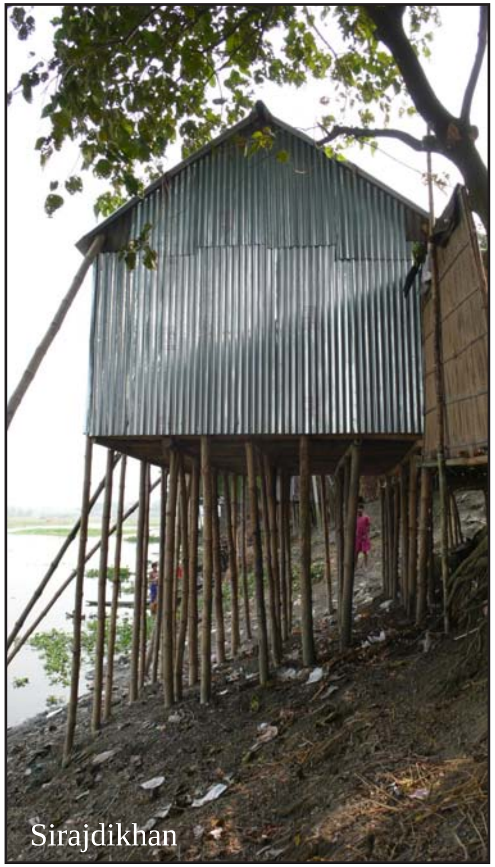
High rising water / building in submerged areas



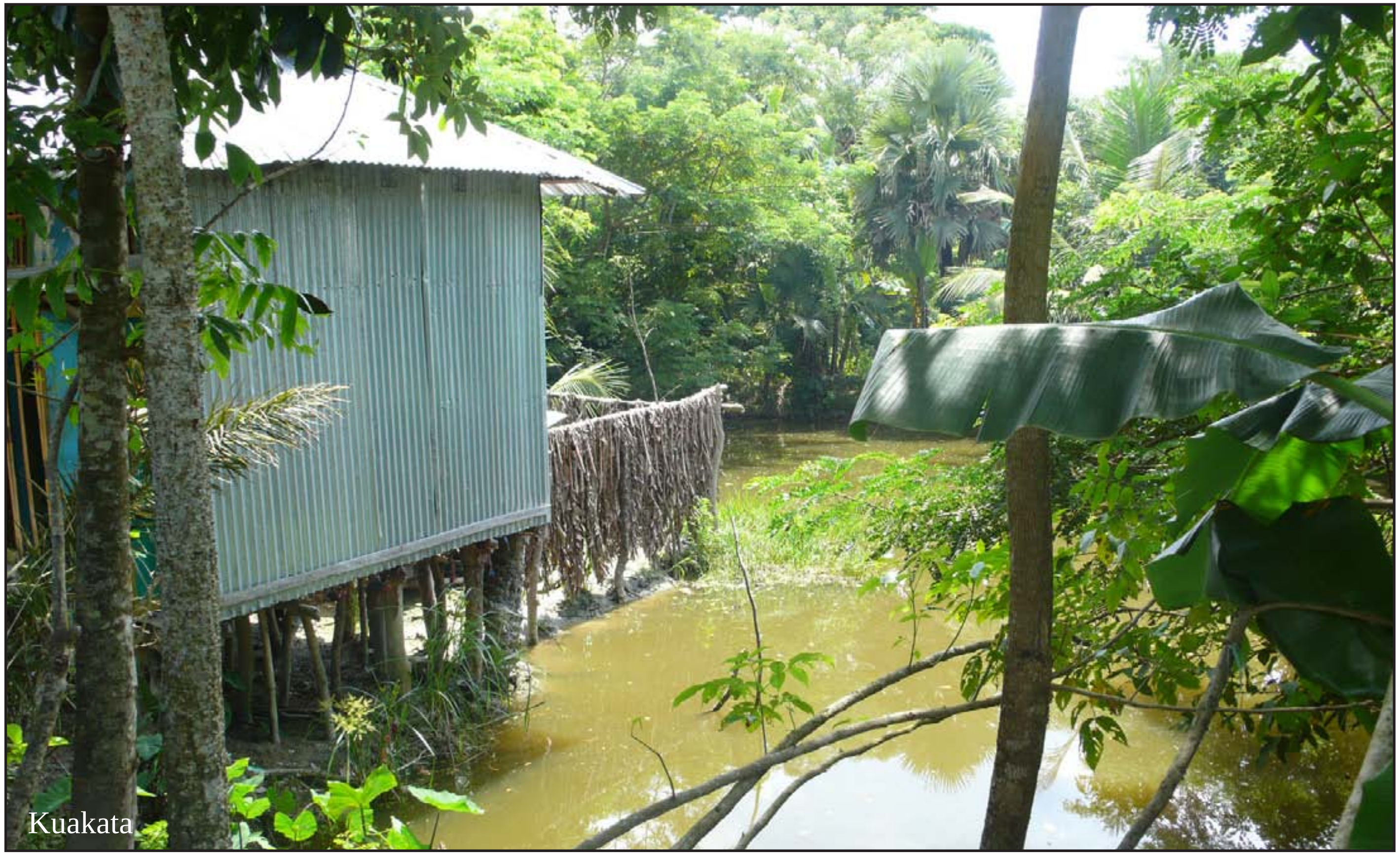


- Protection against recurrent floods -

stilt house



Sirajdikhan

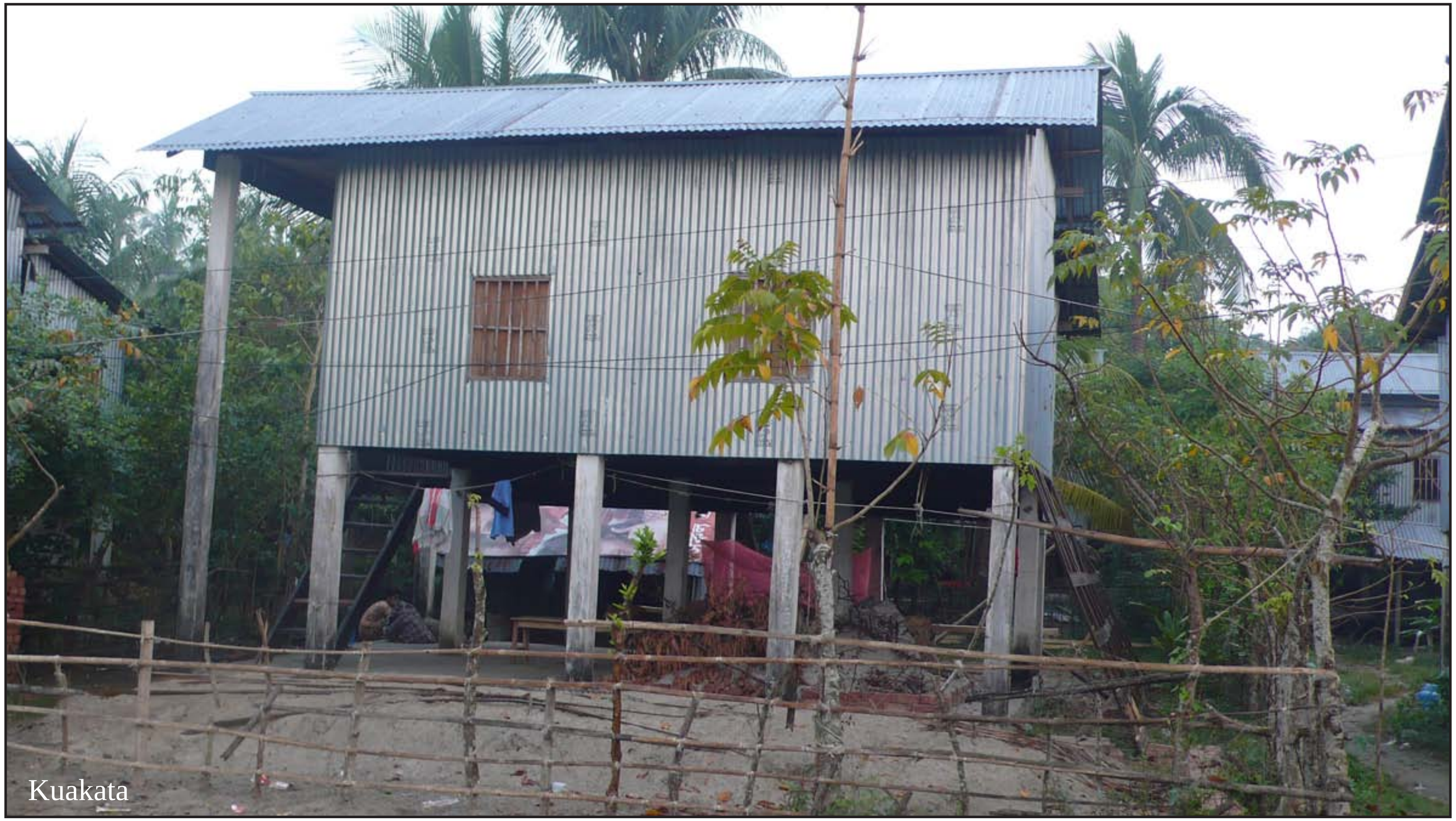


Kuakata

On wooden poles (the more the poles are thin the higher their number will be).

- Protection against recurrent floods -

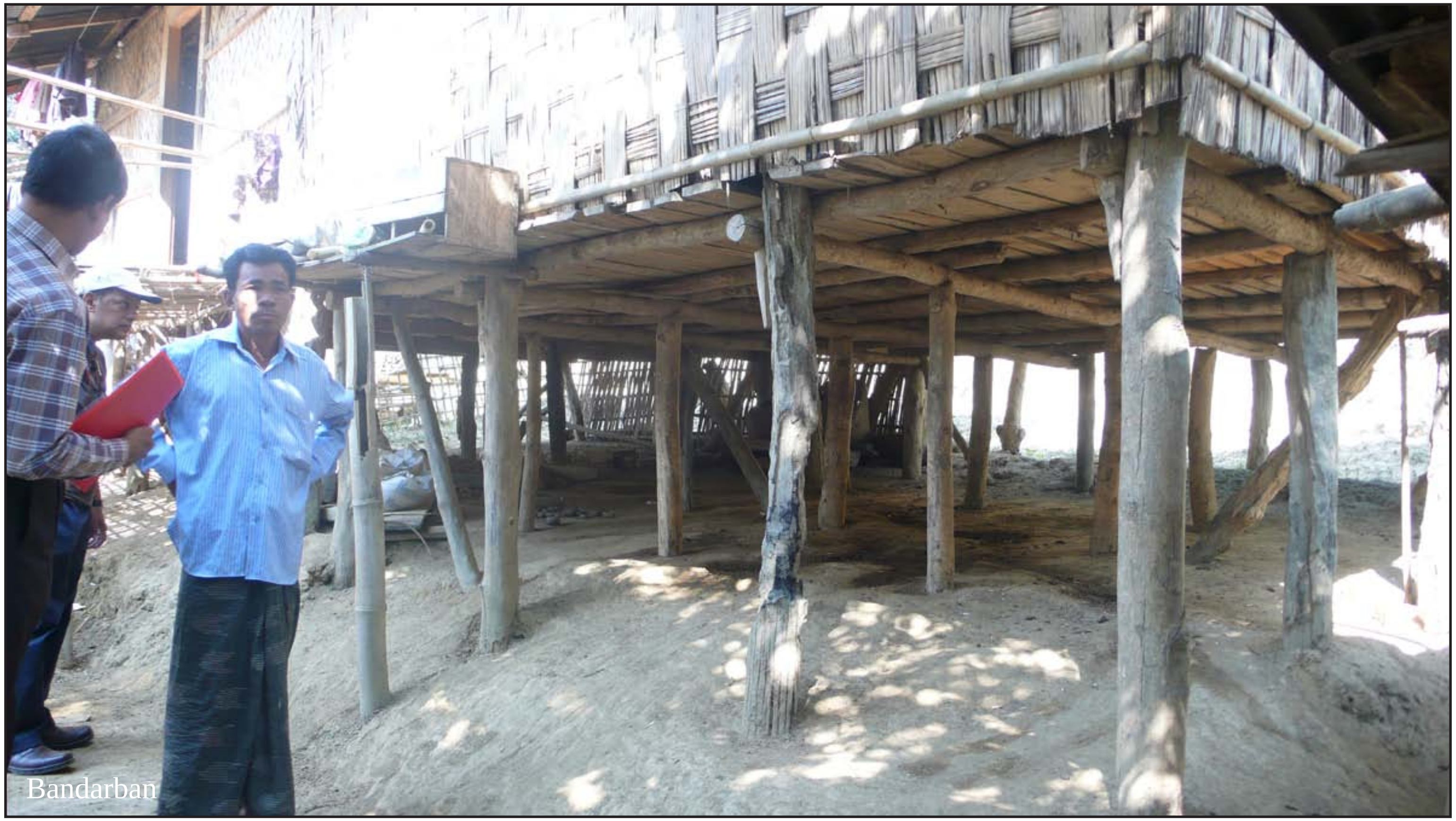
stilt house



On concrete pillars.

- Protection against recurrent floods -

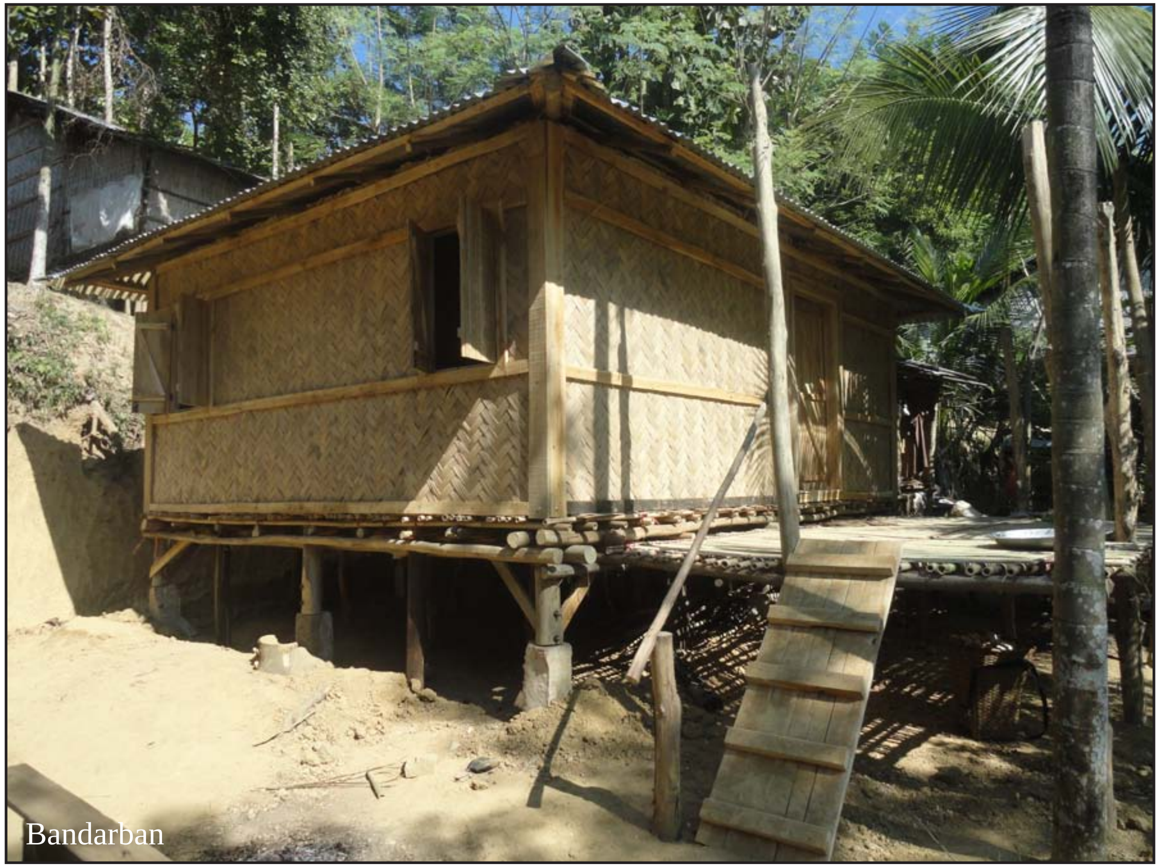
stilt house



Platform on stilts.

- Protection against recurrent floods -

stilt house with outdoor terrace

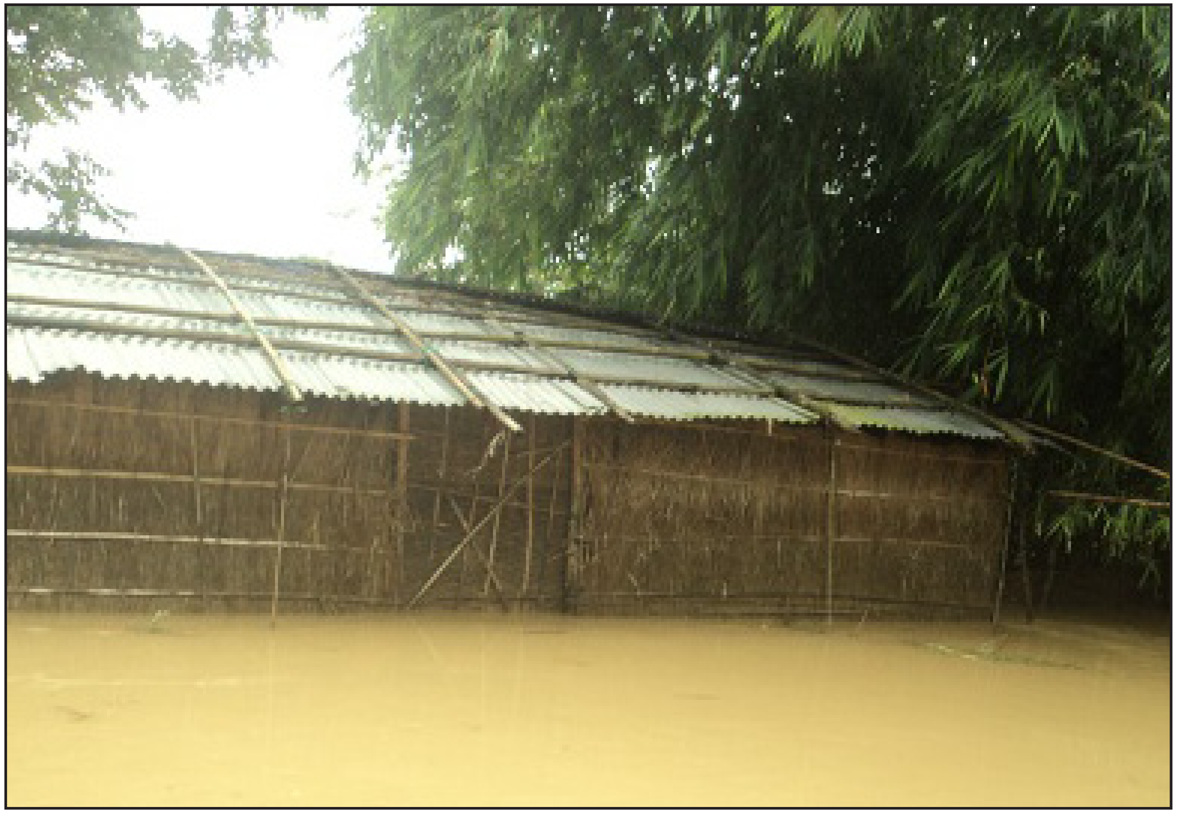


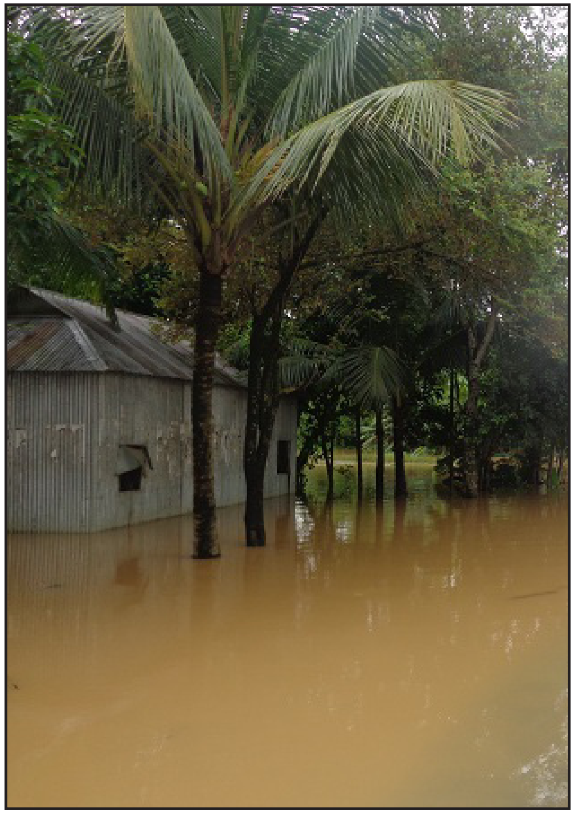
Platform on stilts.

🙁

- FLOODS -

High risk of damage for goods and inhabitants

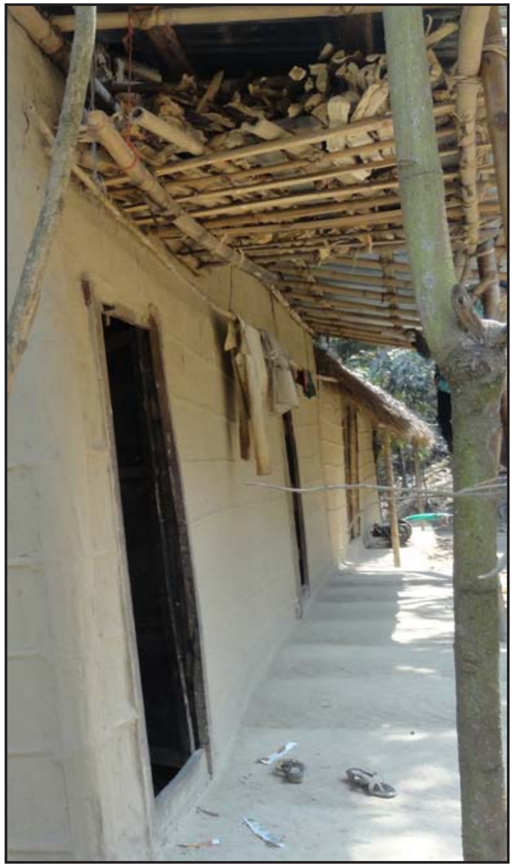


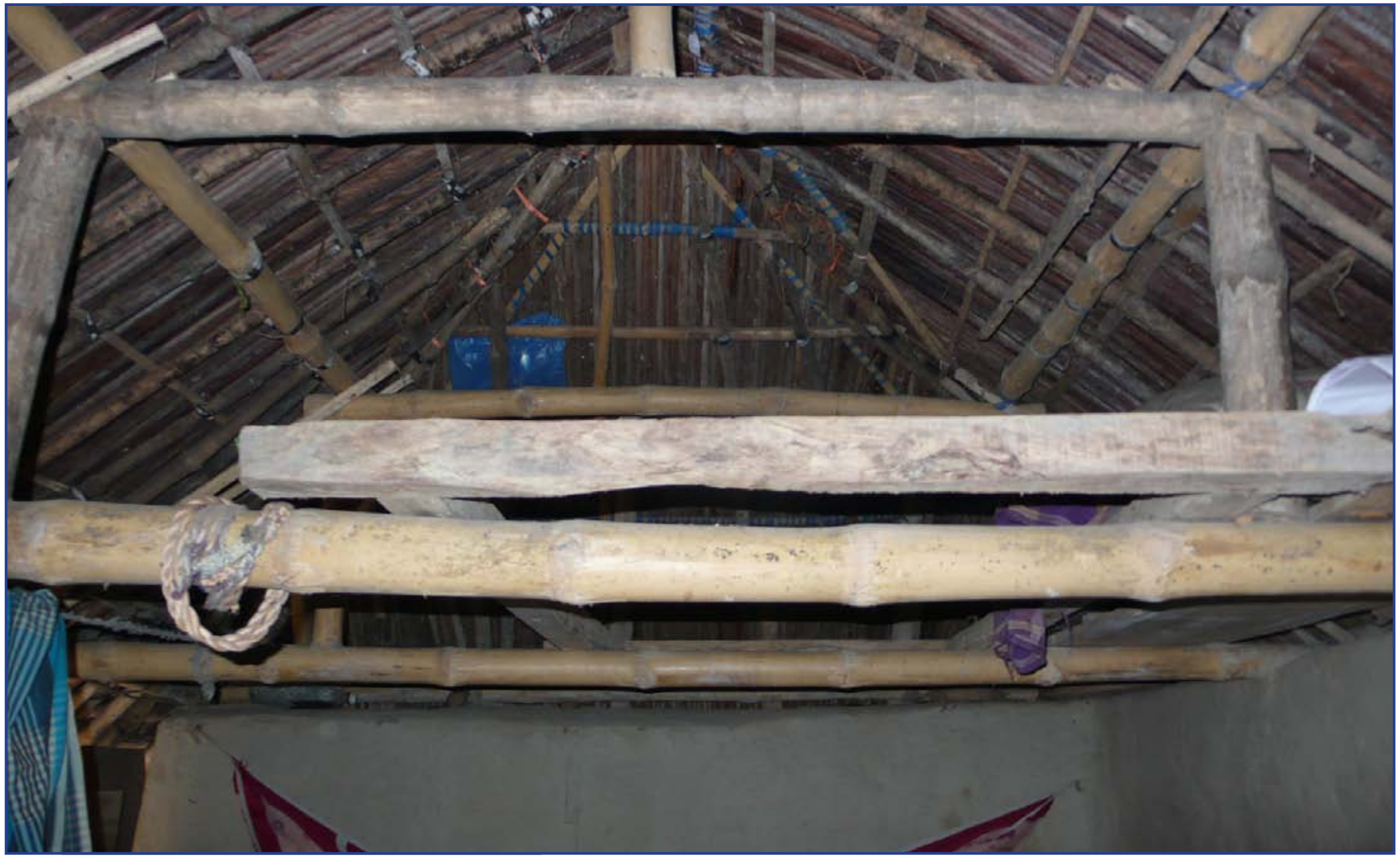


Even though the building keeps standing during the floods, people can be trapped inside by a quick rise of water, as well as goods and food left at the floor level.

- Protection against floods -

light mezzanine system

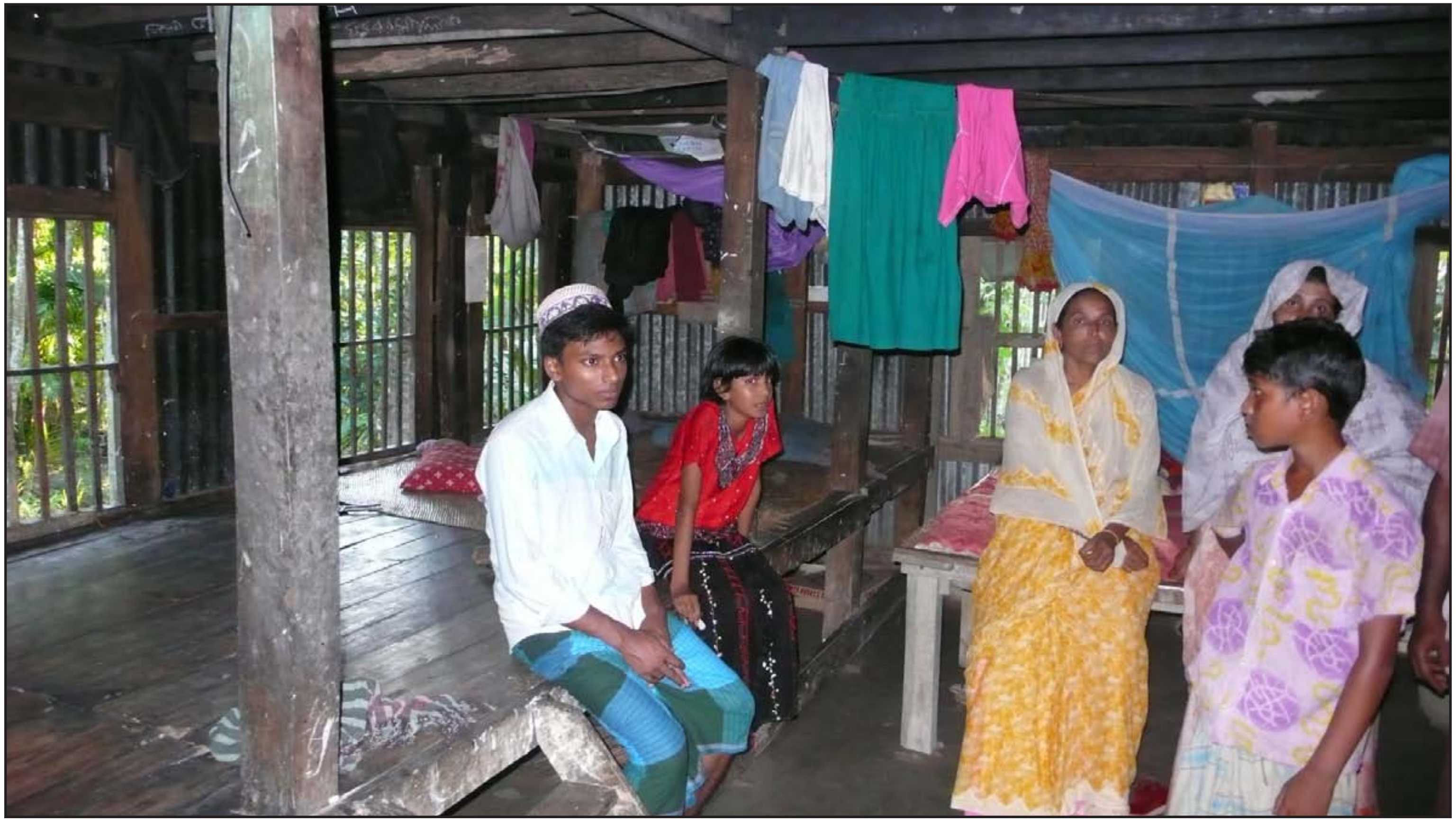




It allows to shelter goods with a reasonable financial investment compared to the risk : light structure.

- Protection against floods -

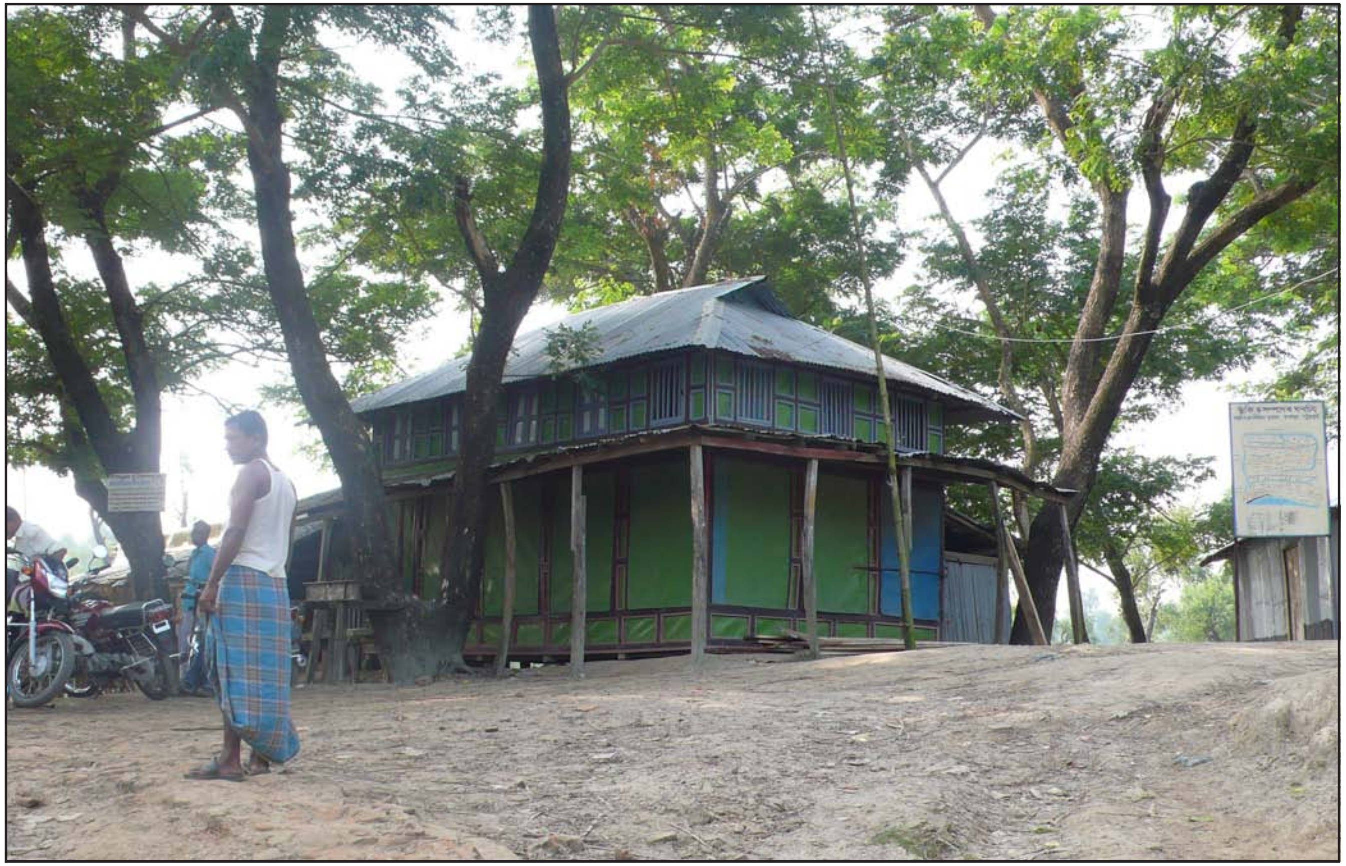
platform, raised furniture

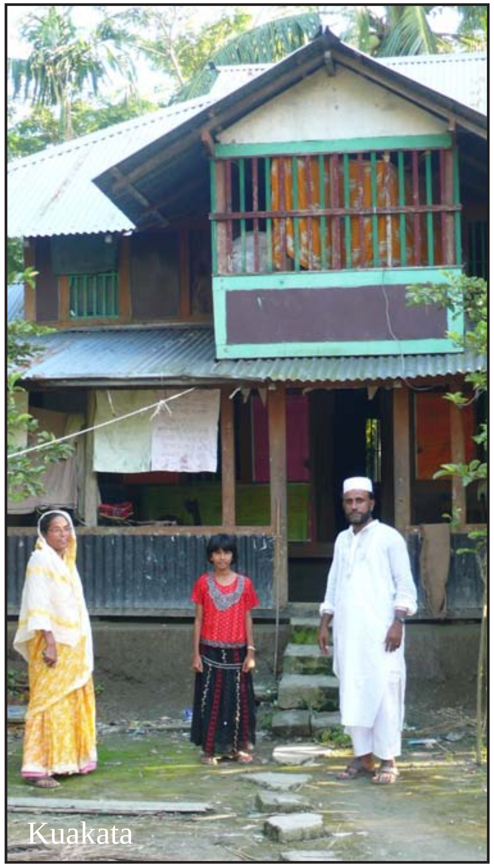


Indoor furniture for keeping safe the goods and to protect oneself from the water accumulated on the ground during floods.

- Protection against floods -

double storey house

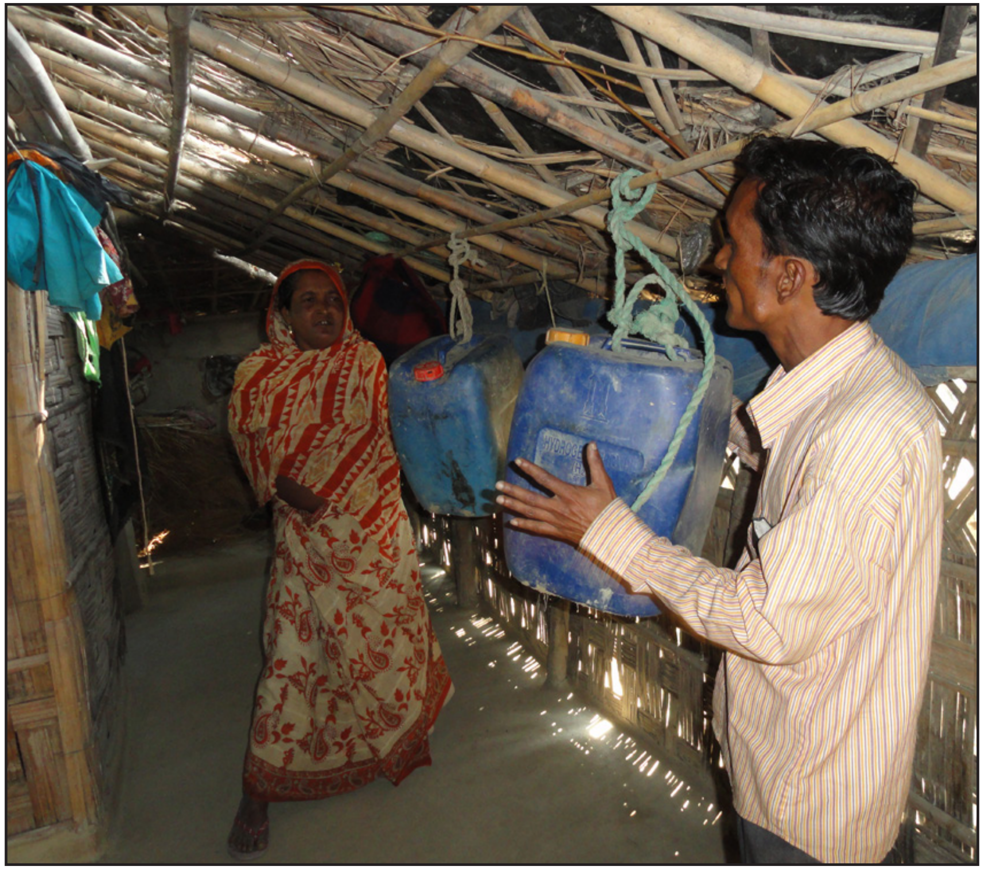


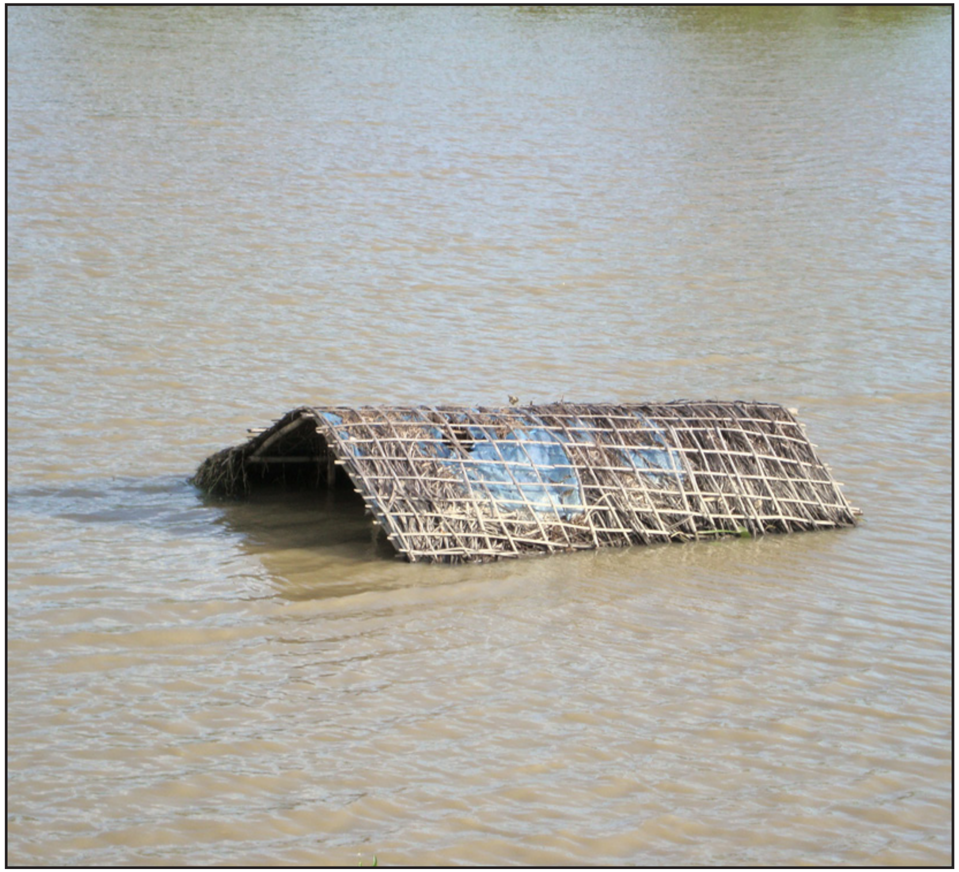


It allows to shelter material goods as well as people in the event of rapid and lasting rising waters. An upstairs window eventually allows emergency evacuation of the house from above.

- Protection against floods -

floating roof

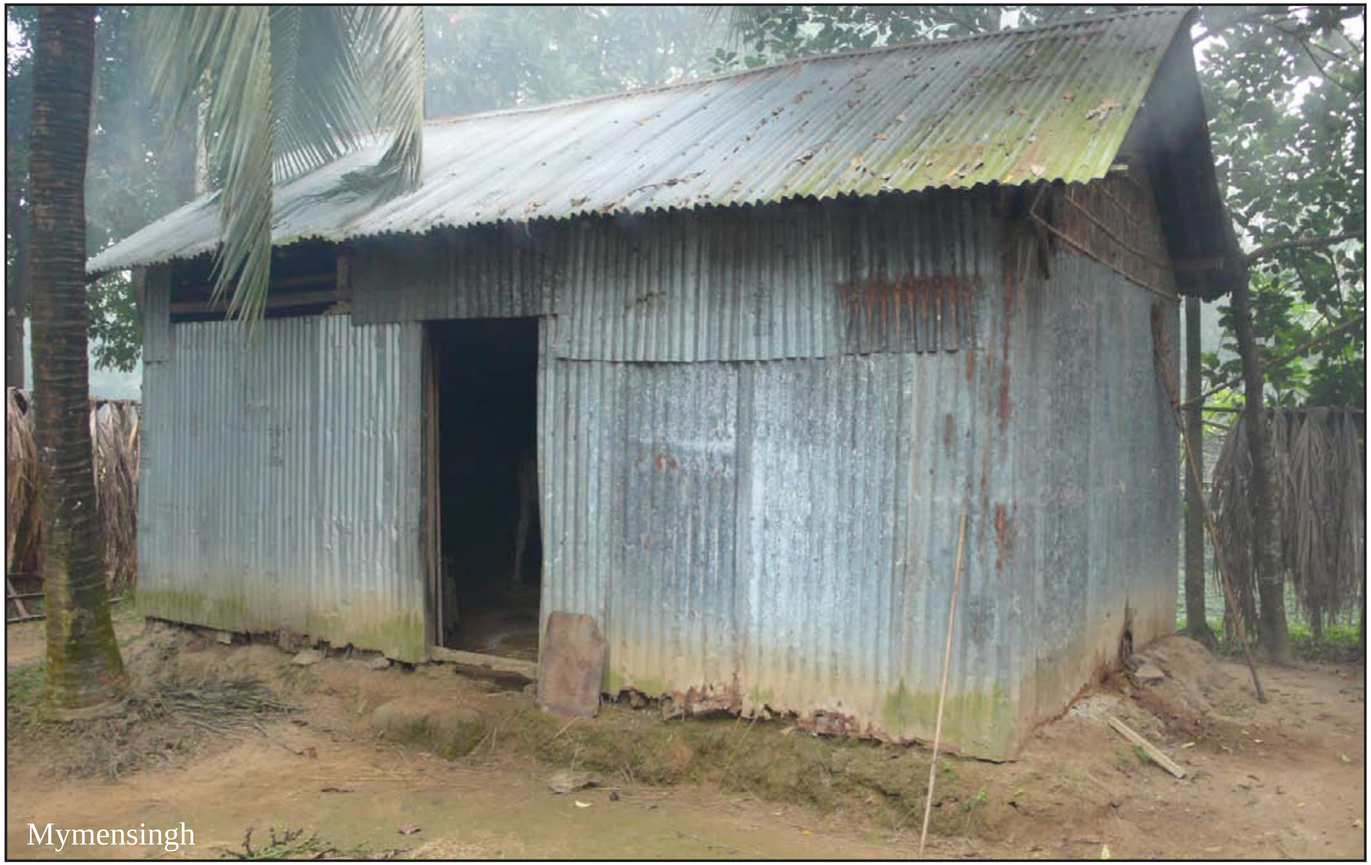




Some empty jerrycans are fastened under the roof structure working as floats and allowing the covering to keep staying above the water level.
This solution can significantly reduce damages and it makes possible to recover the roof.

- FLOODS -

Wall base damaged

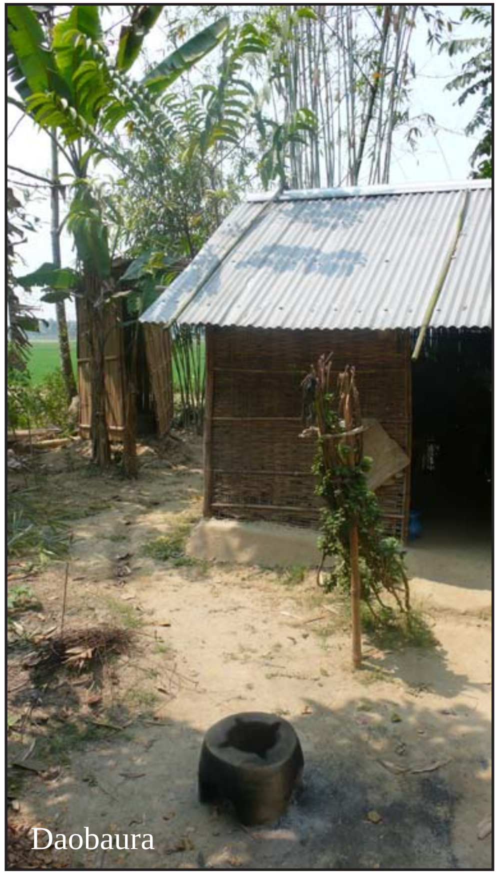

Mymensingh

Ashashuni

The part of the wall in contact with water got damaged.

- Protection against floods -

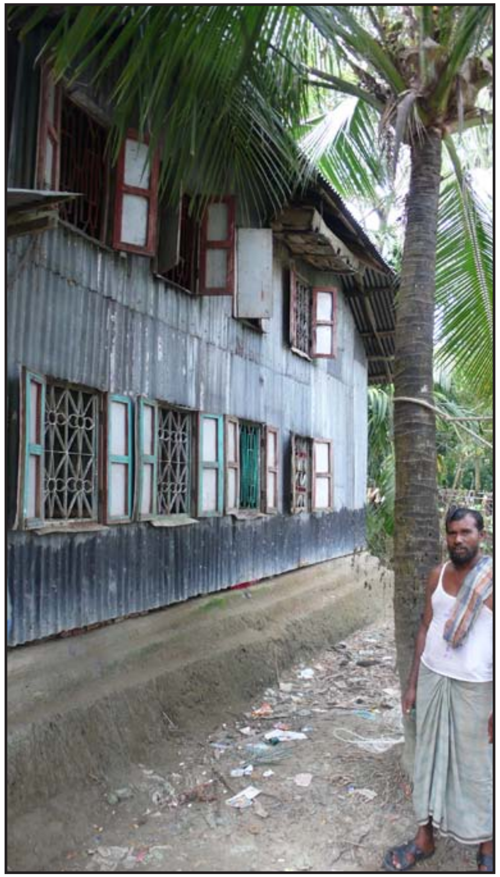
house upon earth platform

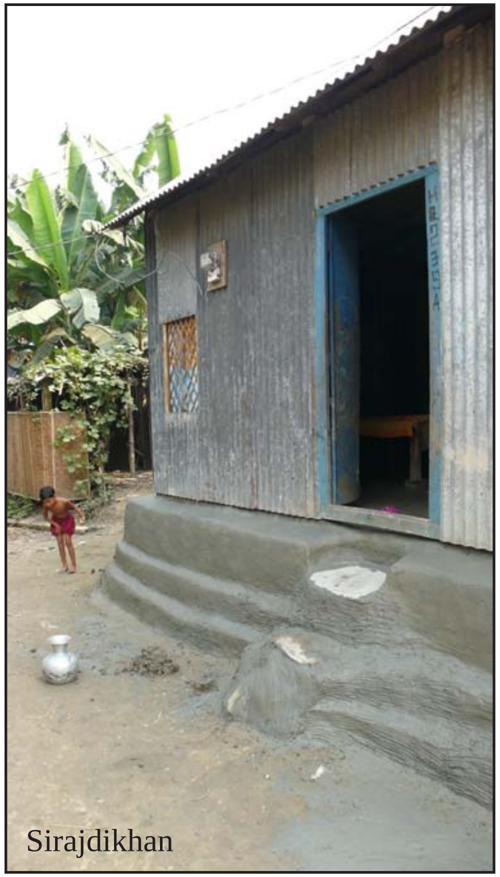


Interior platform which raises the building and protect it from water and moisture.

- Protection against floods -

staircase platform



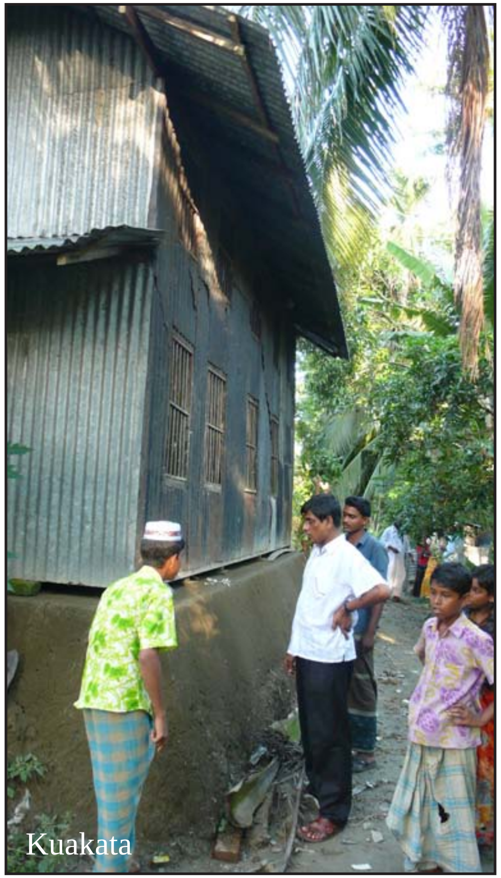


Sirajdikhan

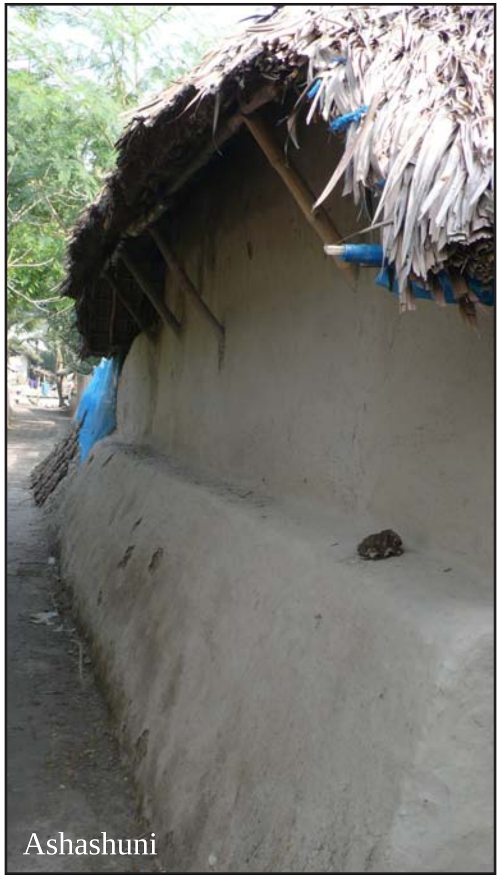
The staircase shape works as a wear mass all around the perimeter. This mass will protect the platform and the building but it will be eroded by water ; a seasonal maintenance has to be foreseen.

- Protection against floods -

high platform and overhanging roof



Kuakata

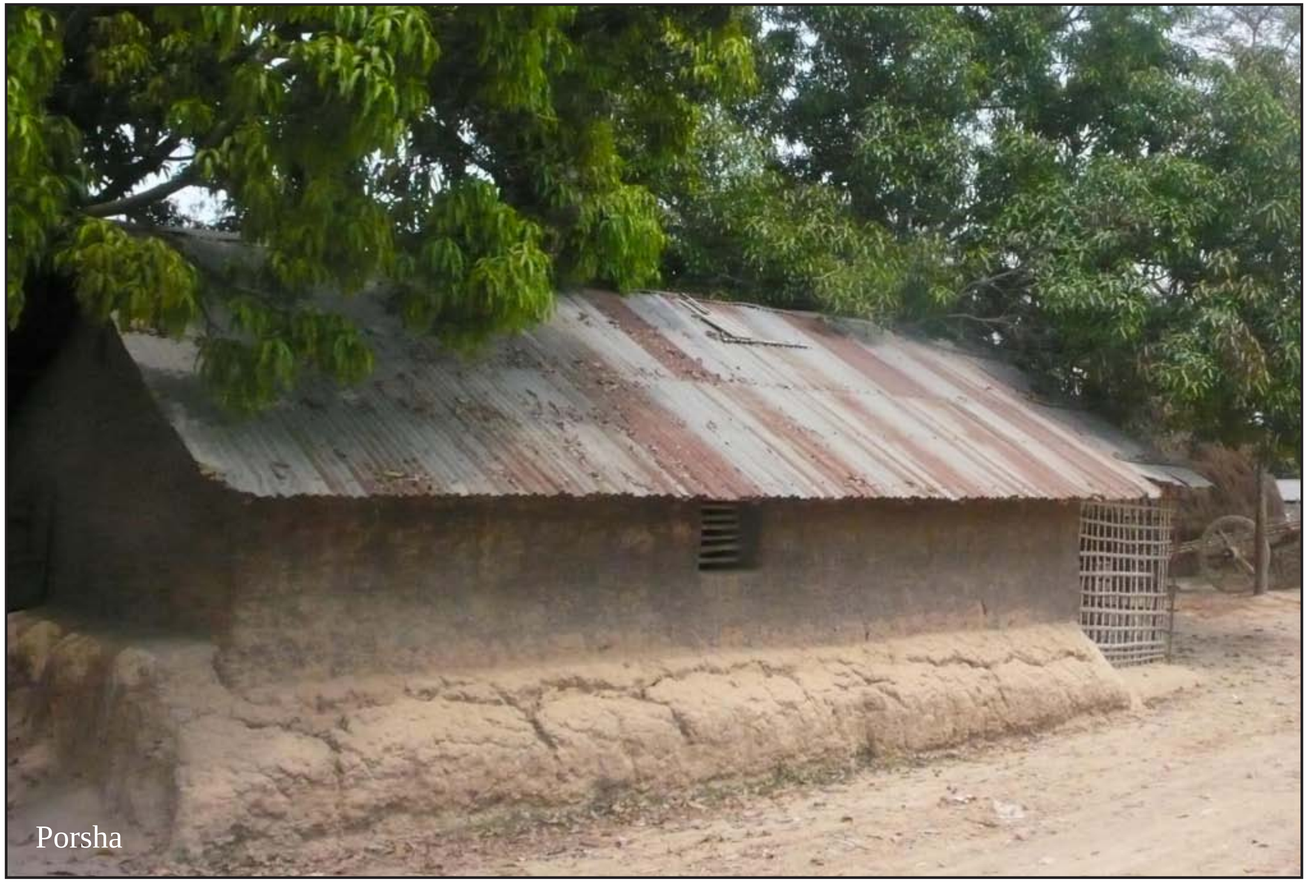


Ashashuni

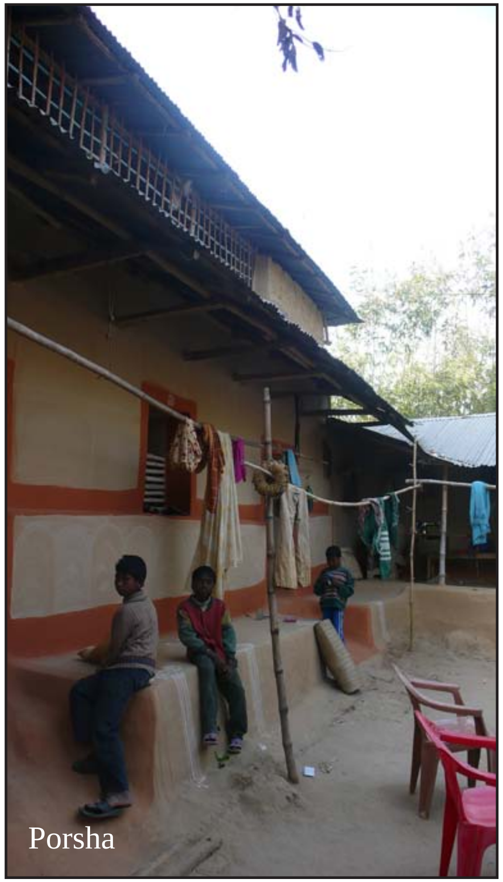
A higher platform prevents from more consistent water rise. A larger overhanging roof protect the platform from rain erosion.

- Protection against floods -

wide platform and overhanging roof



Porsha

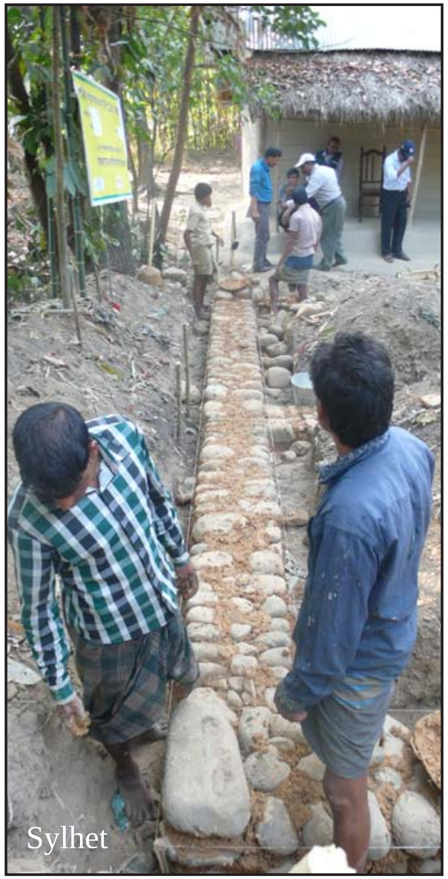


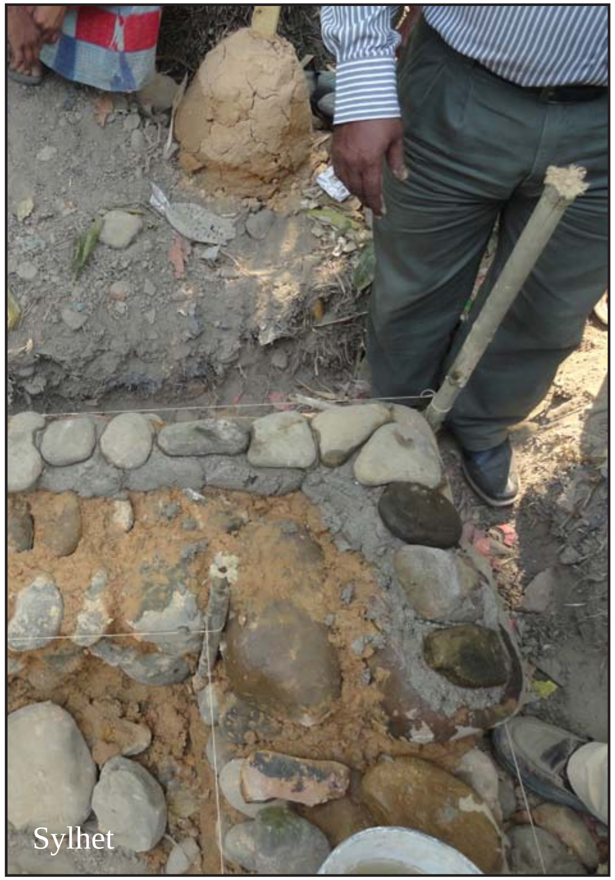
Porsha

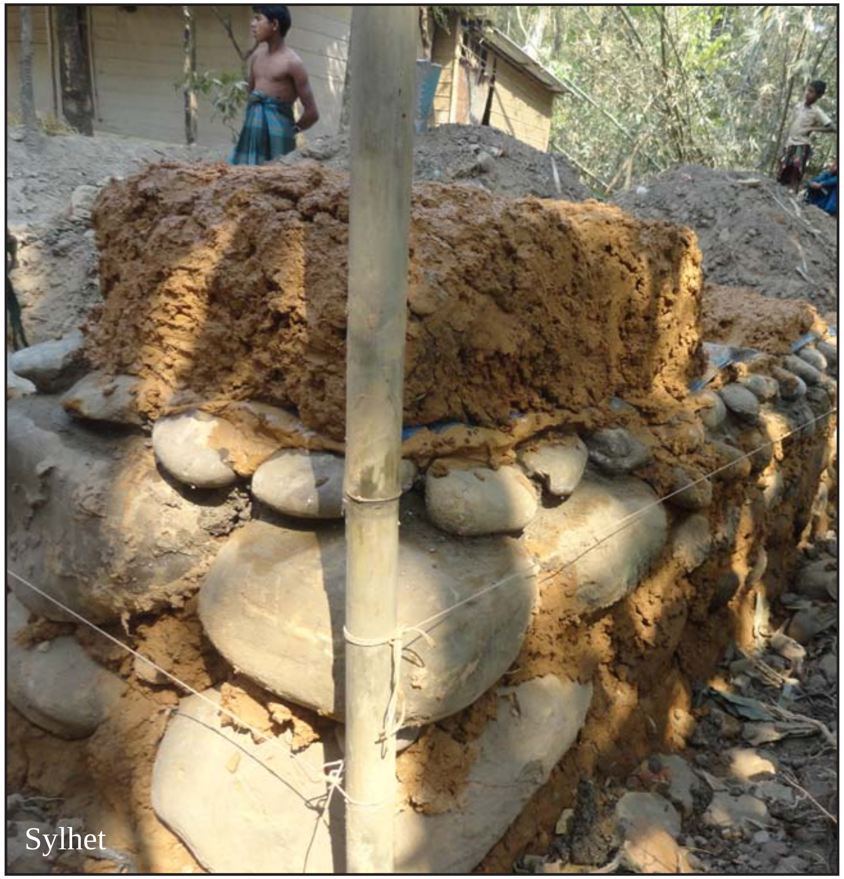
The platform, acting as a wear mass, will last longer and it will keep away floods from the building. The overhanging roof will protect the mass from rain erosion.

- Protection against floods -

platform with stone reinforced edge



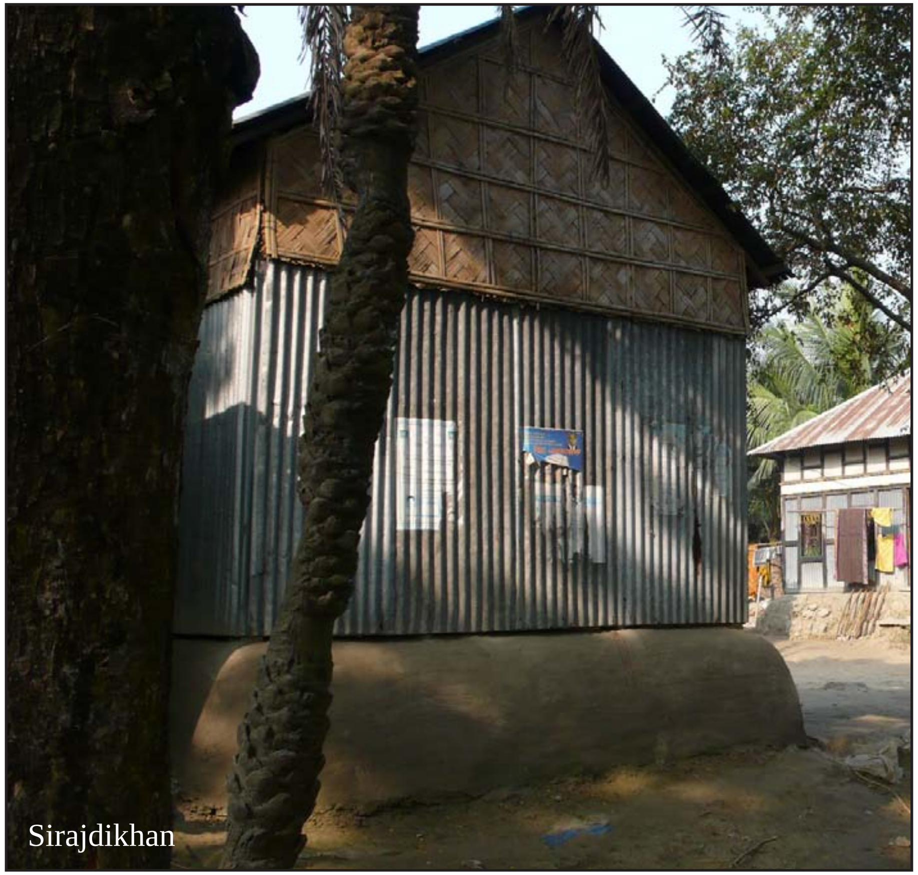




The stone reinforcement further strengthens the platform.

- Protection against floods -

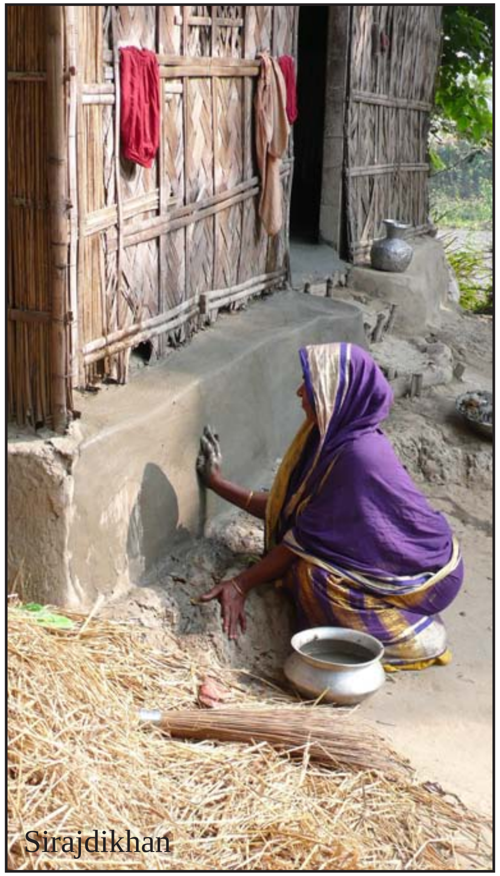
platform and mixed walls

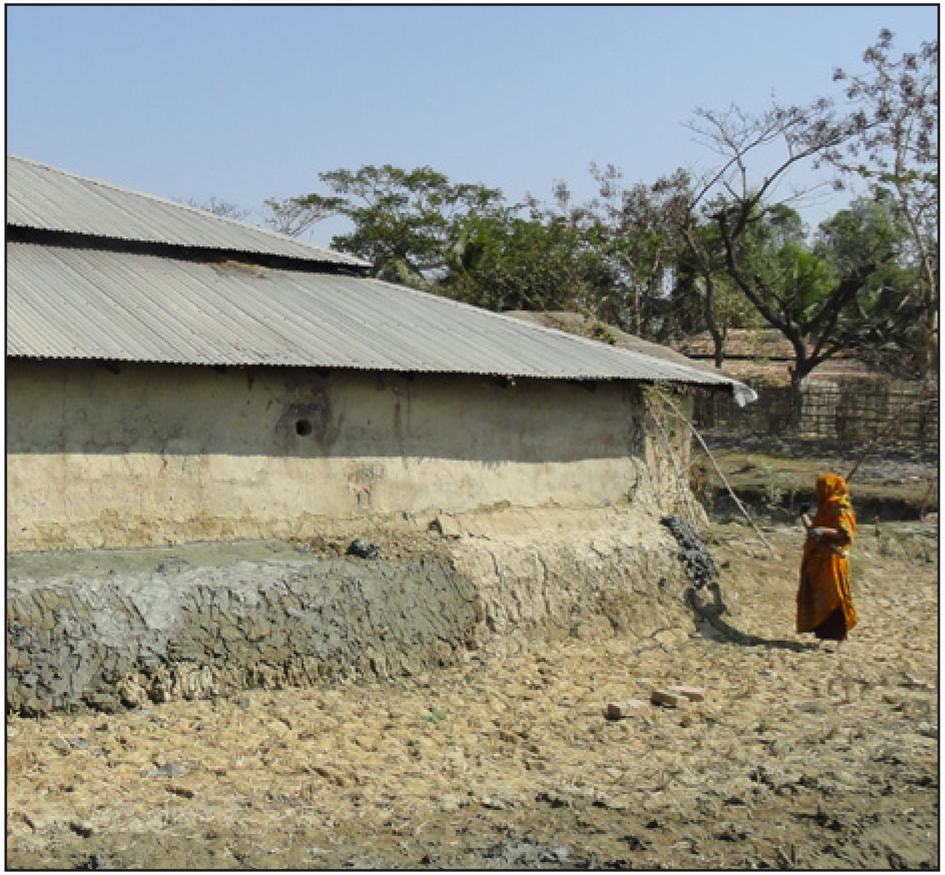


In order to reduce the cost of the building, different construction materials can be used. Water proof materials may be choosen for the ground flioor while lighter and more vulnerable options can be used in the higher part of the house.

- Protection against floods -

platform protection with soil plaster

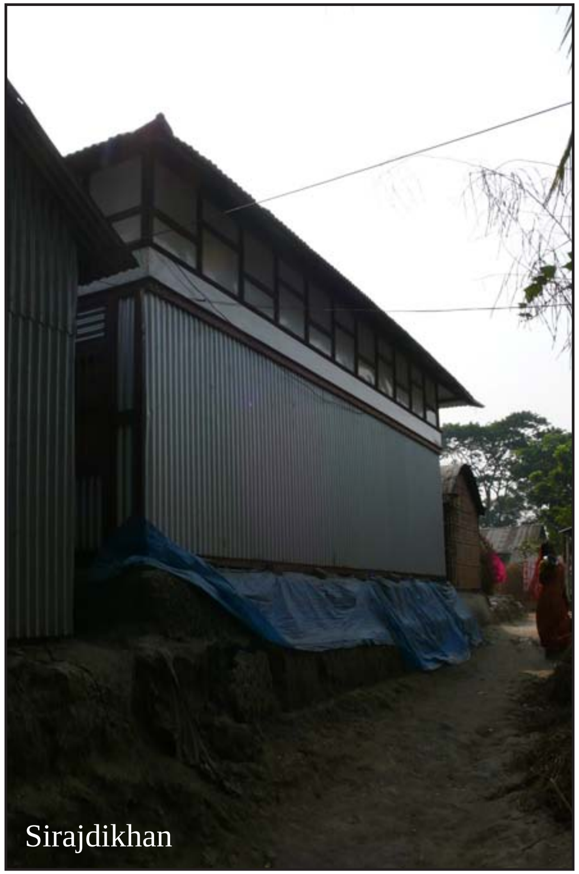




Regular maintenance of the wear mass. A cheap solution which makes the platform lasting and keeping play his role.

- Protection against floods -

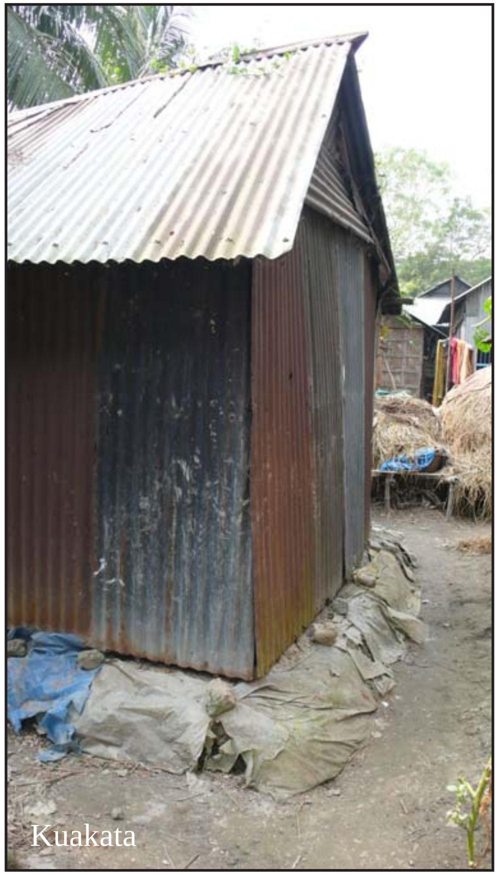
plastform protection with plastic sheet

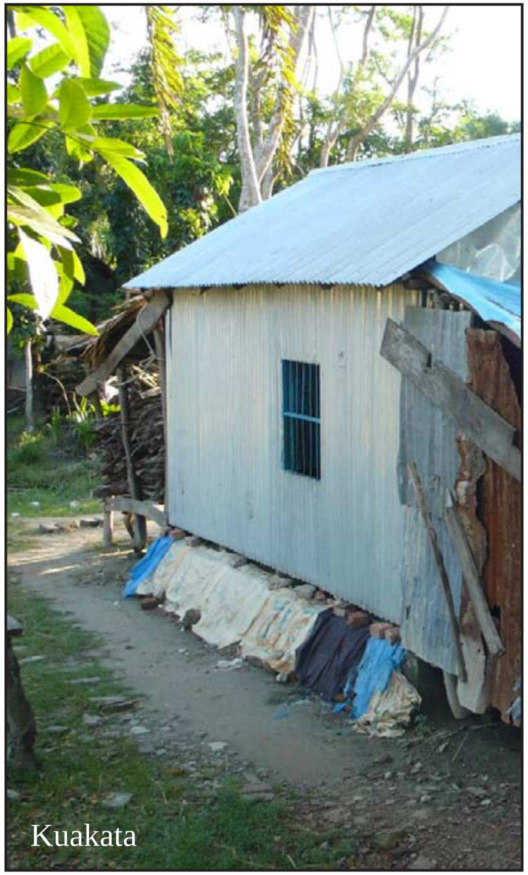


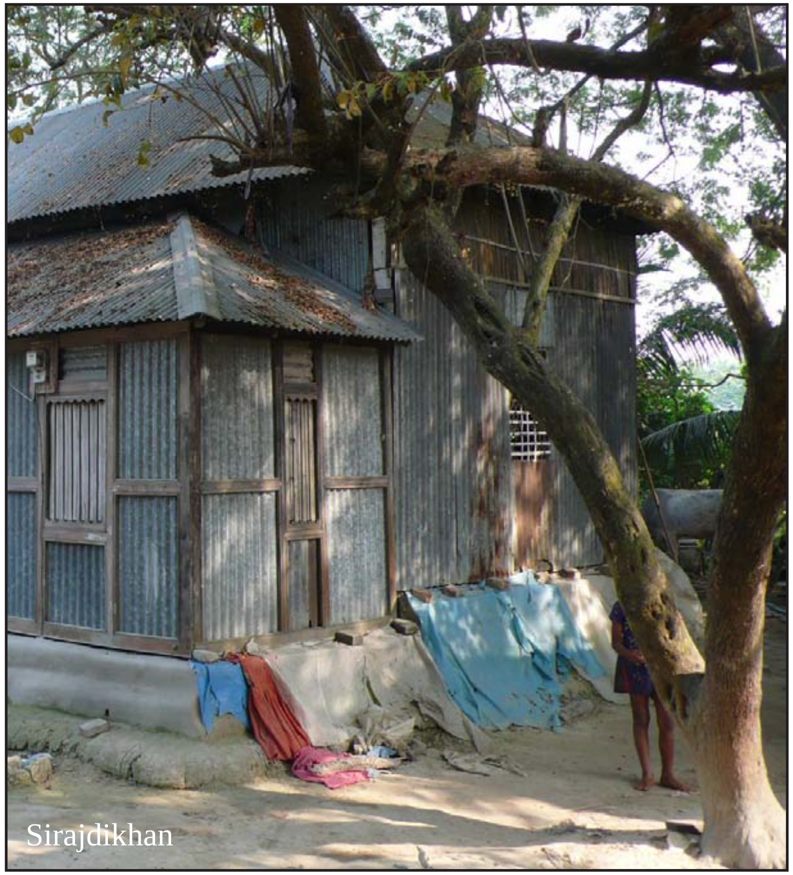
This protection must be installed as a temporary solution so as to allow the water to evaporate and to avoid the platform to get weak.

- Protection against floods -

plastform protection with textile


Kuakata

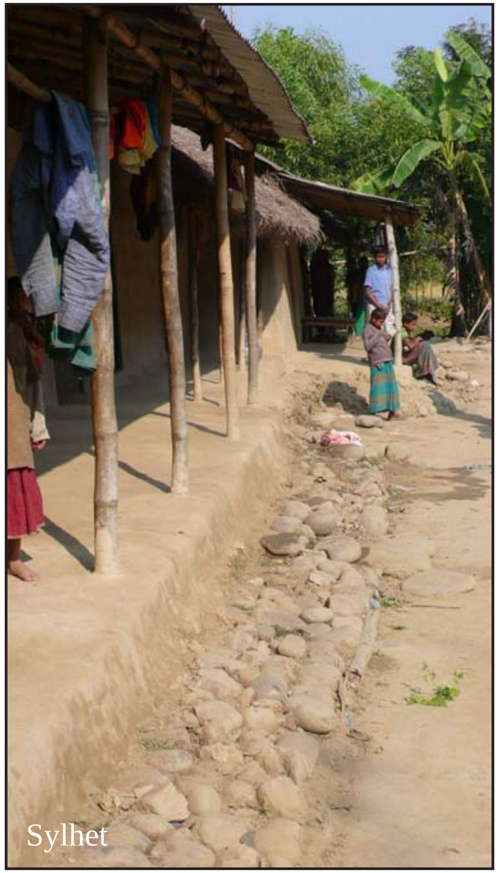

Kuakata

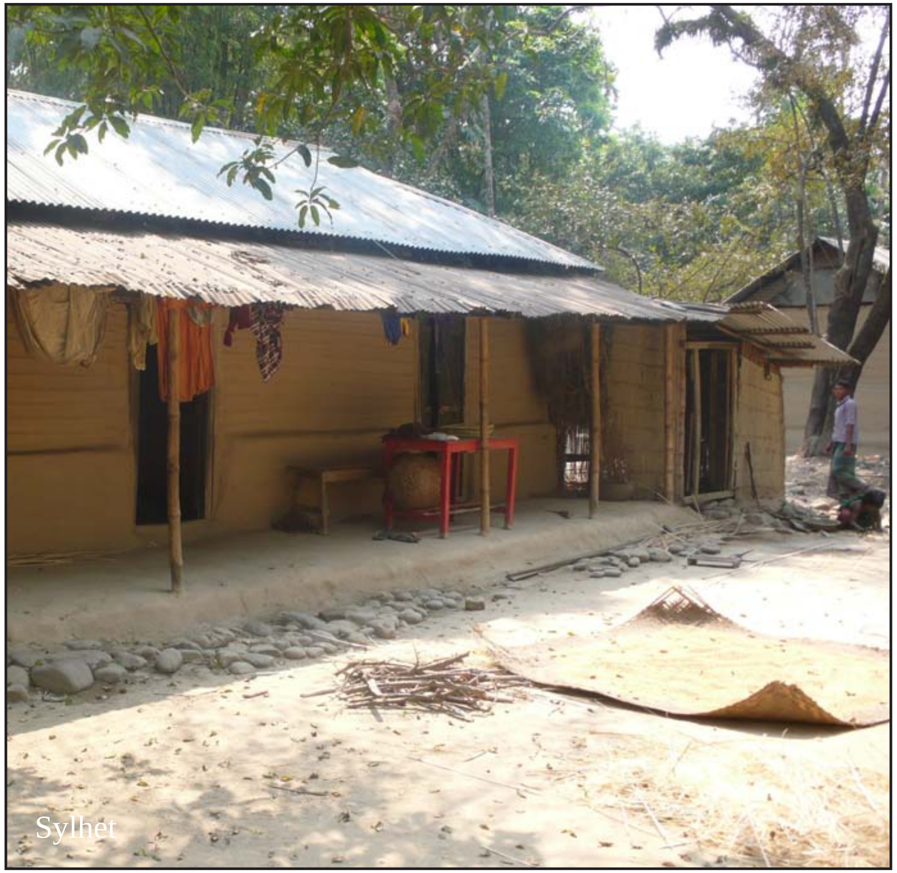

Sirajdikhan

This water proof protection must be laid on a temporary base. To keep it in place would avoid water to evaporate and thus it will affect the platform resistance.

- Protection against floods -

platform protection with stones

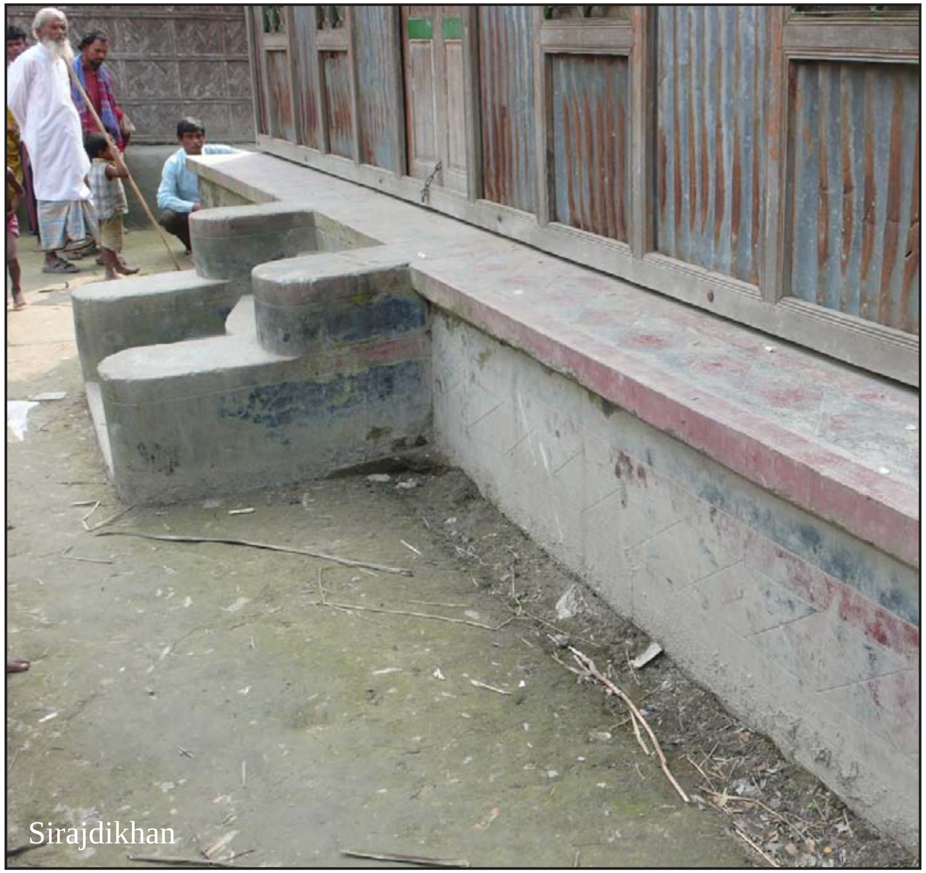


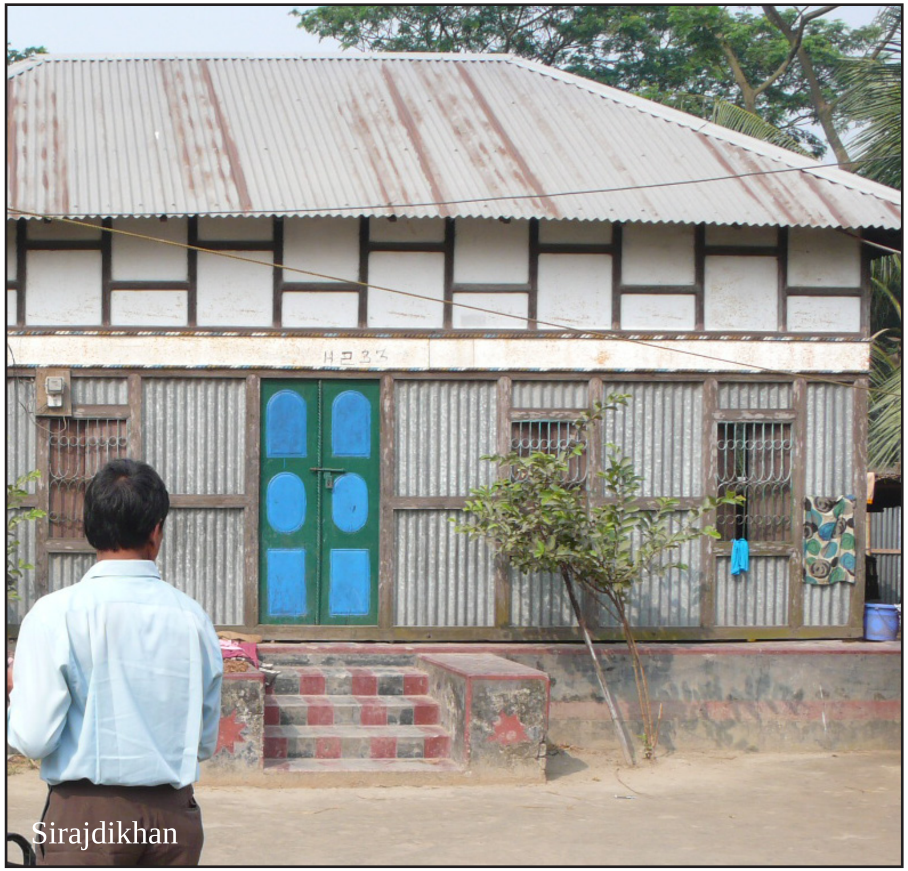


Laying stones all around the platform perimeter so as to prevent erosion.

- Protection against floods -

platform protection with fired bricks

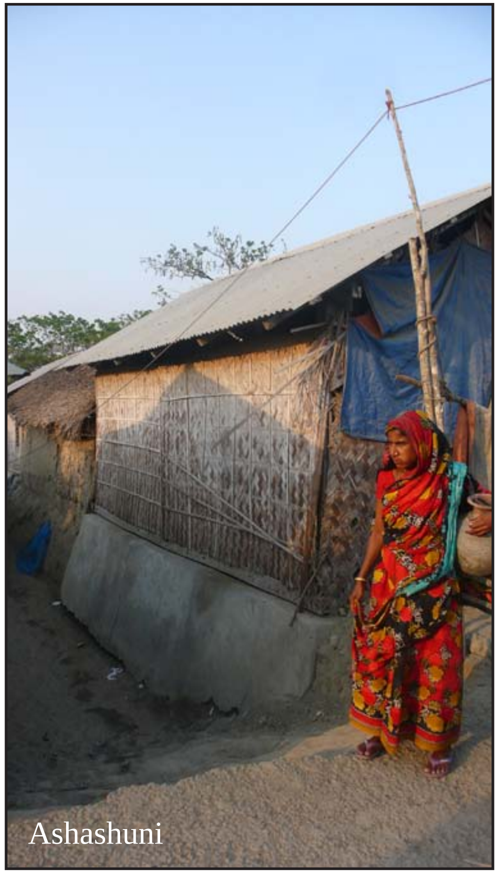

Sirajdikhan


Sirajdikhan

Platform protection against erosion by covering with a water proof material : fired bricks.

- Protection against floods -

platform protection with cement mortar covering

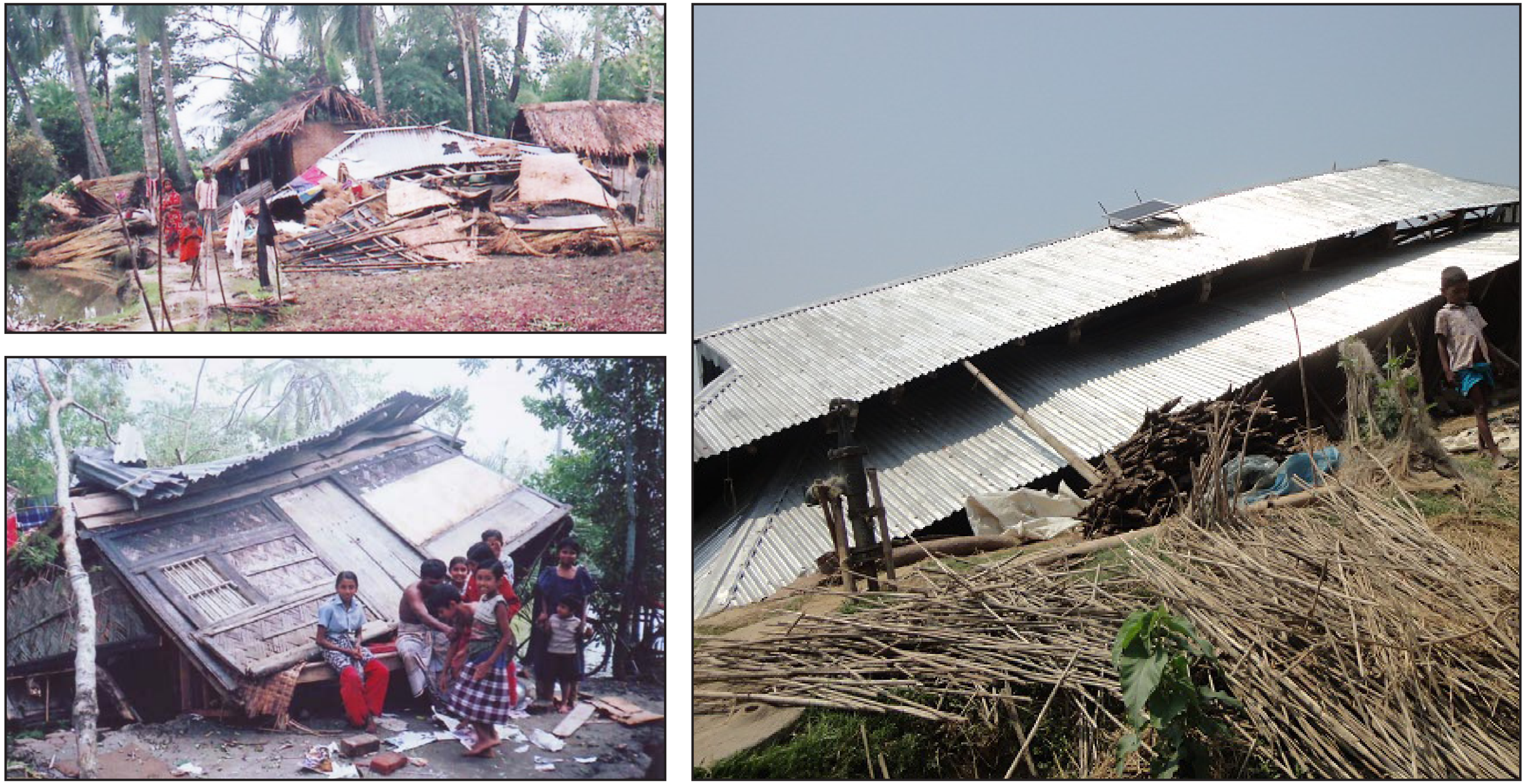


Ashashuni

Platform protection against erosion by covering with a water proof material : cement mortar.
Warning ! The cement mortar doesn’t stick to the soil and it may peel off. Water infiltration between the wall and the mortar can cause serious damages, the water being unable to evaporate.

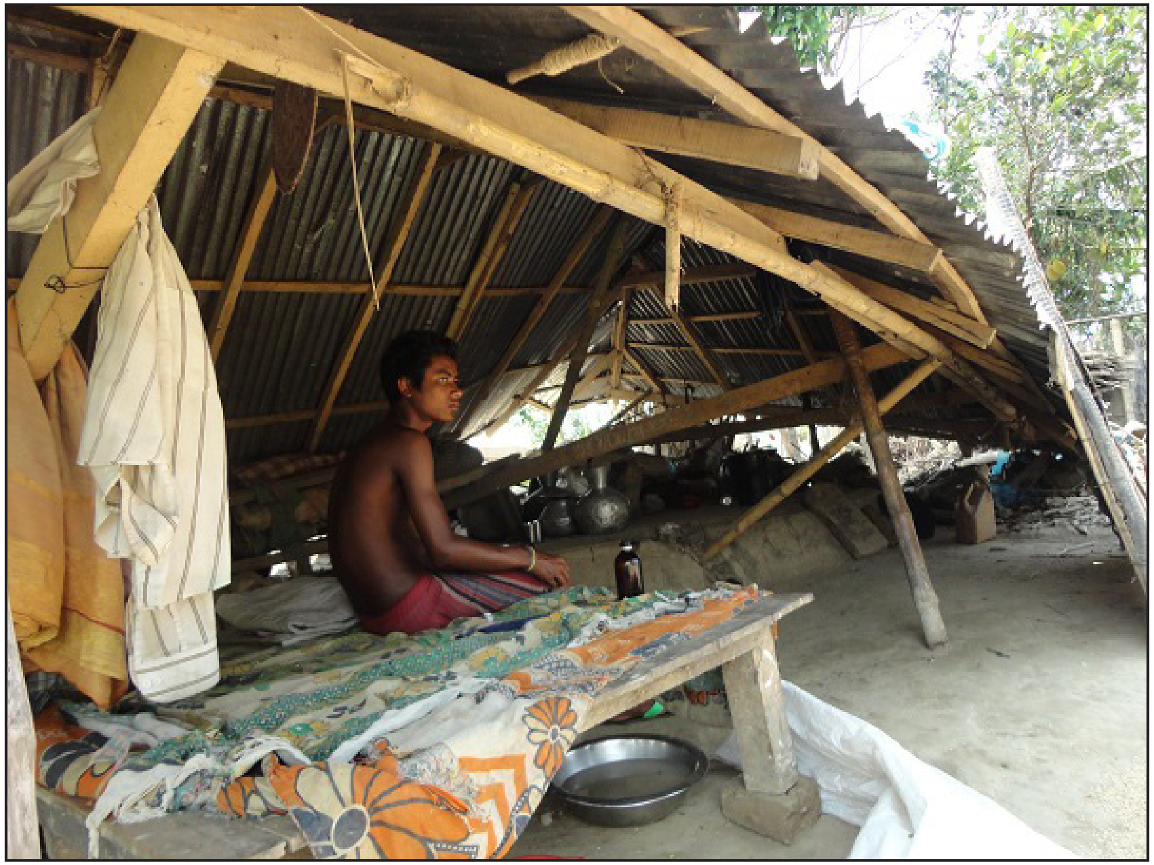
- STRONG WINDS -

House bended / laid down



- Protection against strong winds -

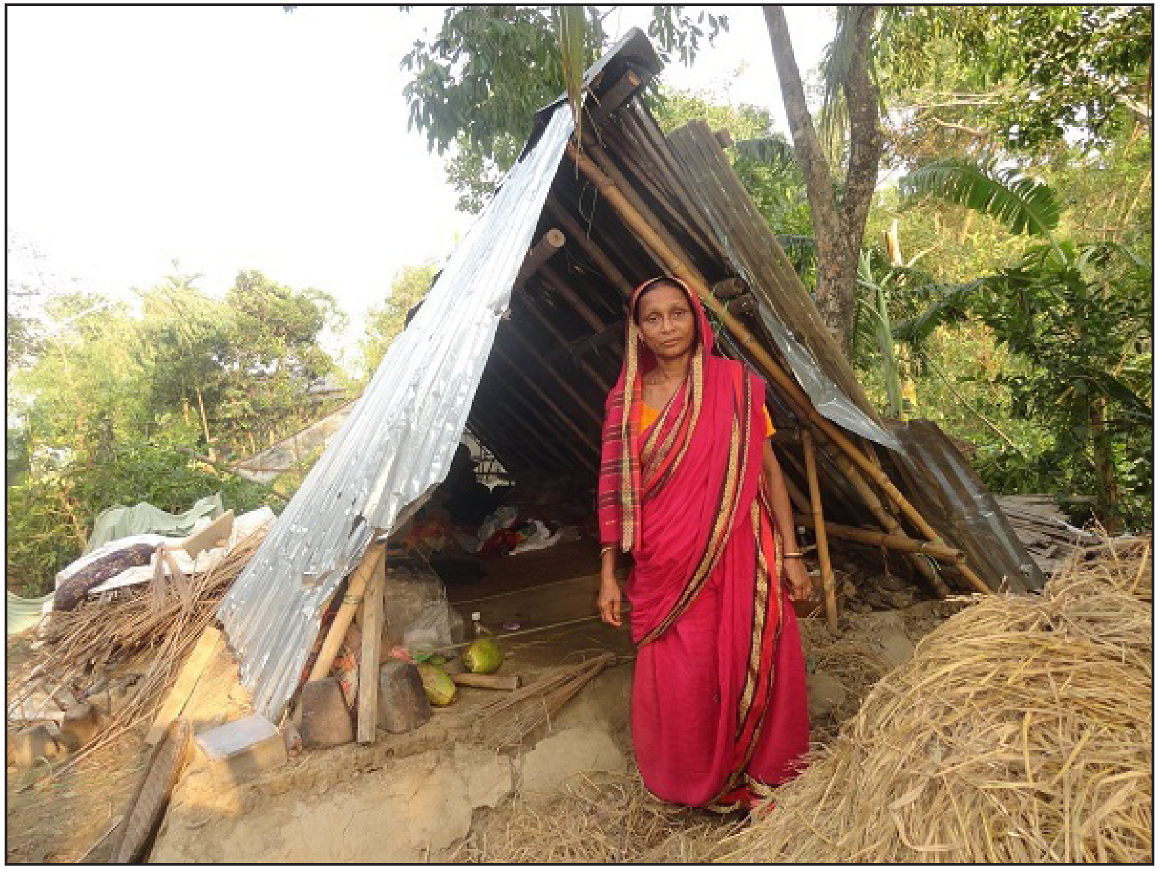
emergency solution waiting for reconstruction



Raising up a part of the collapsed house by temporary poles installed to allow to build a provisional shelter.

- Protection against strong winds -

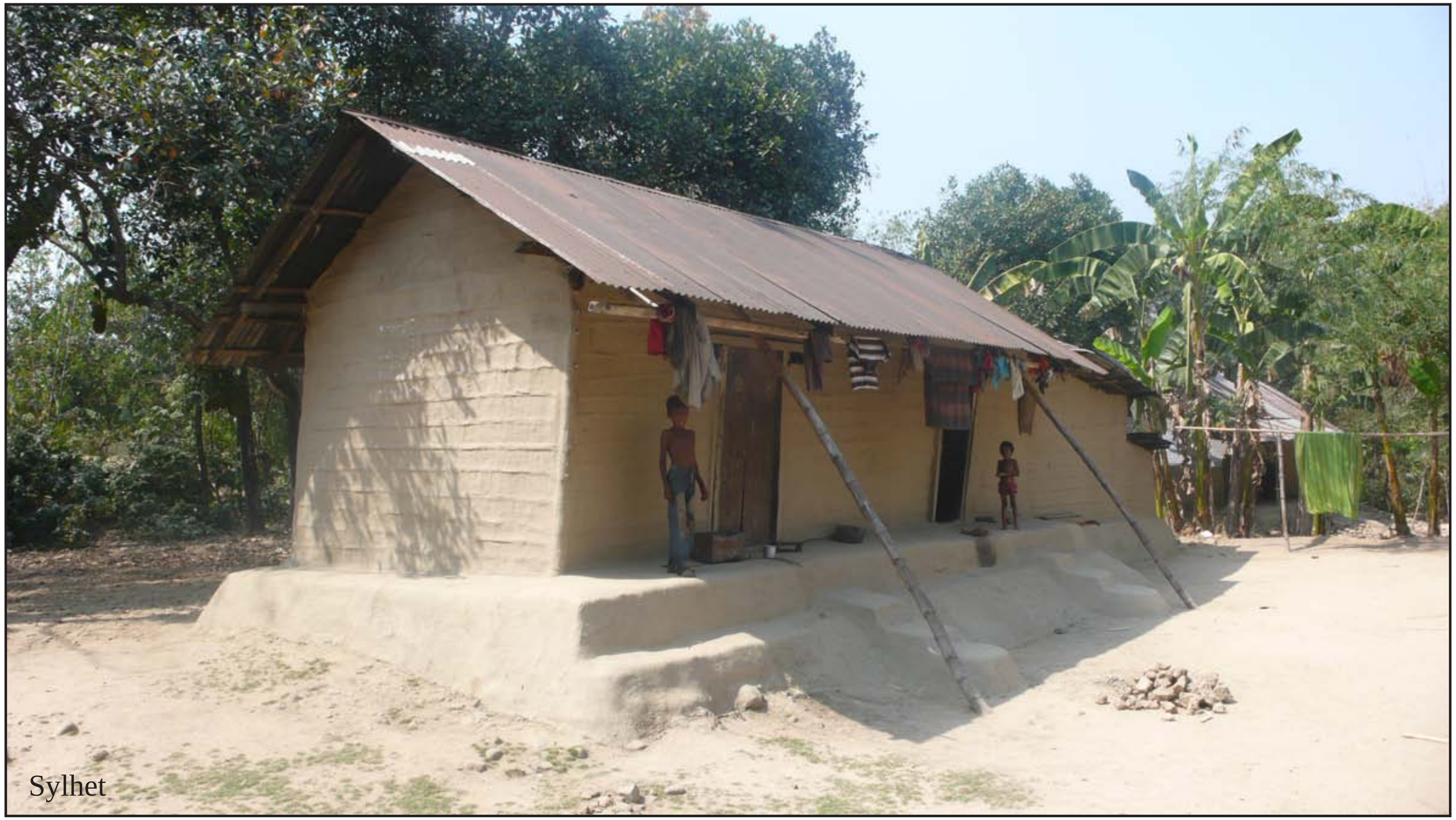
emergency solution waiting for reconstruction



Recovery of some materials from the collapsed building in order to build a temporary shelter.

- Protection against strong winds -

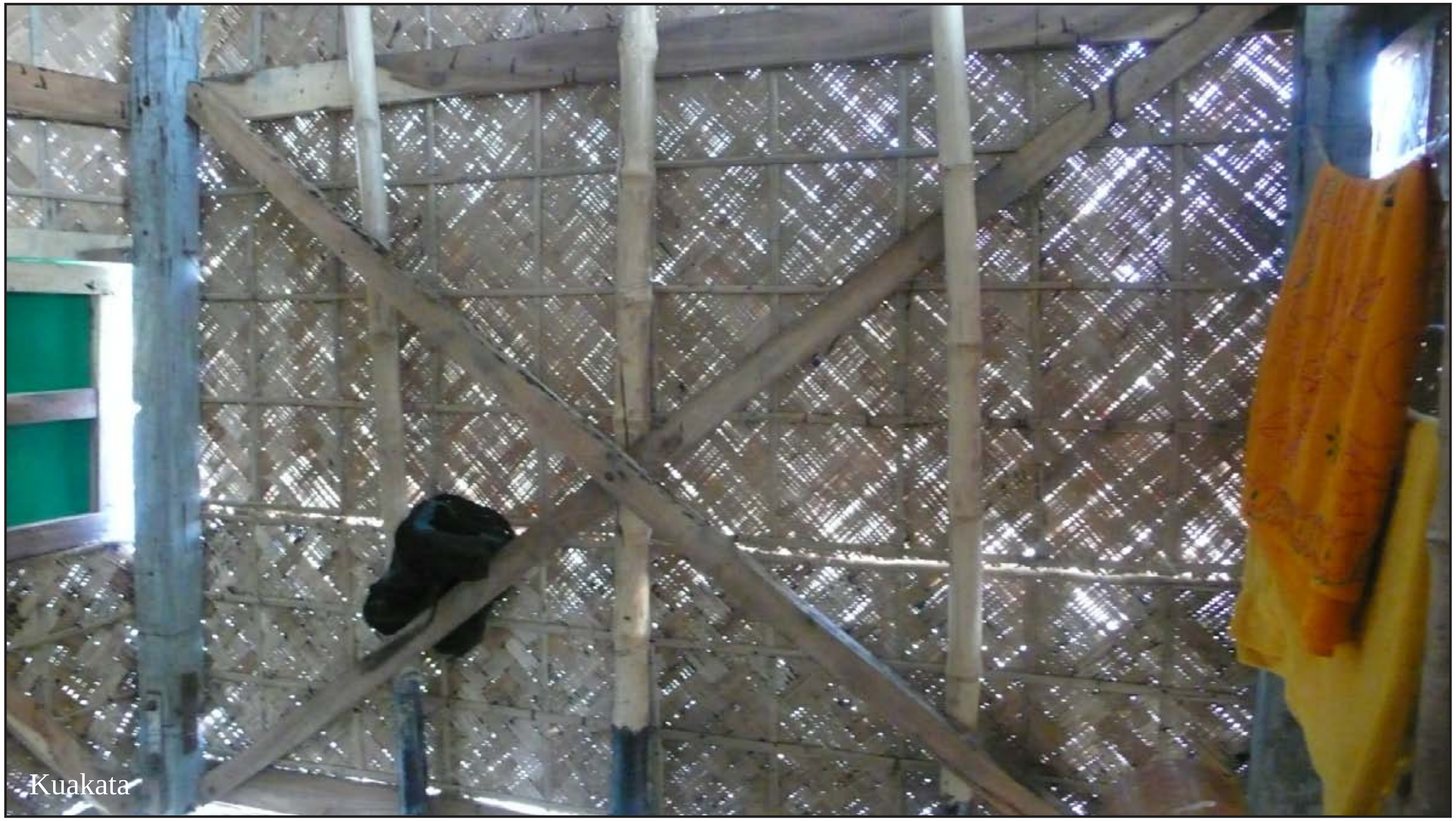
outdoor protection against tipping



Slanted wood poles avoid the house to bend under wind pressure ; they work as bracing.

- Protection against strong winds -

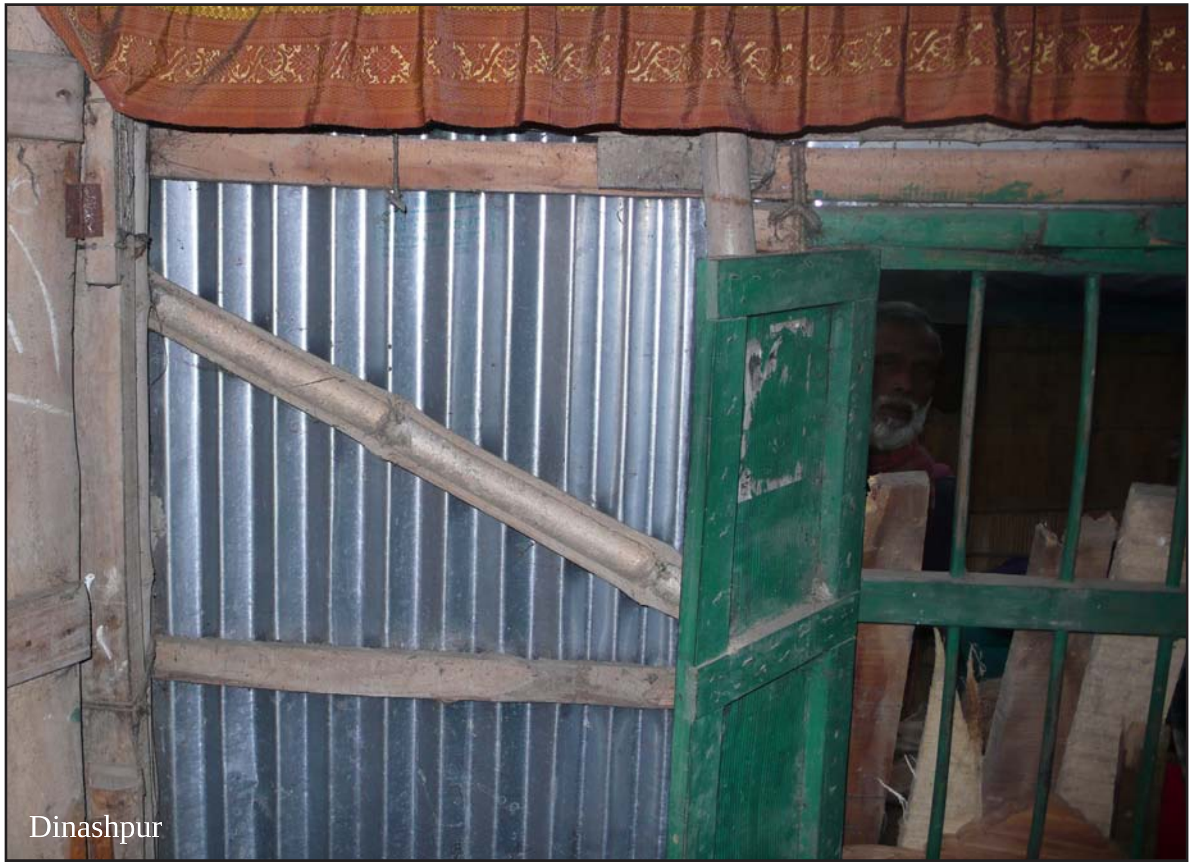
double long wall bracing



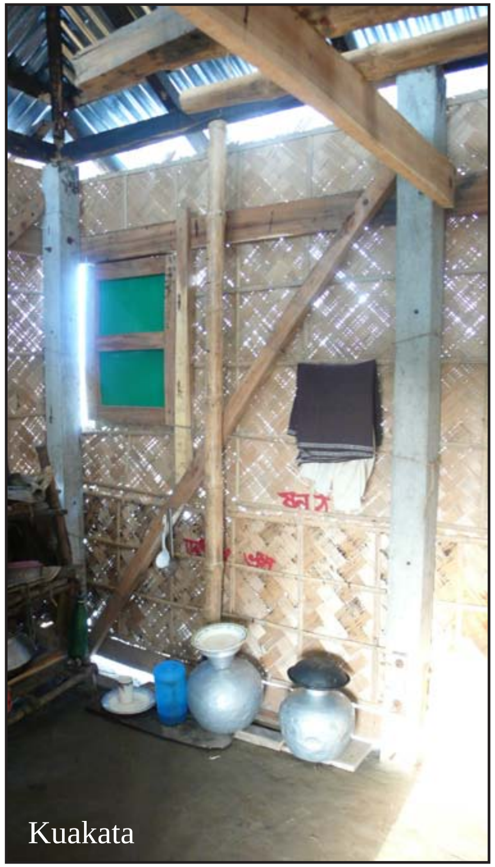
Bracing avoid the structure to bend.

- Protection against strong winds -

long wall bracing



Dinashpur

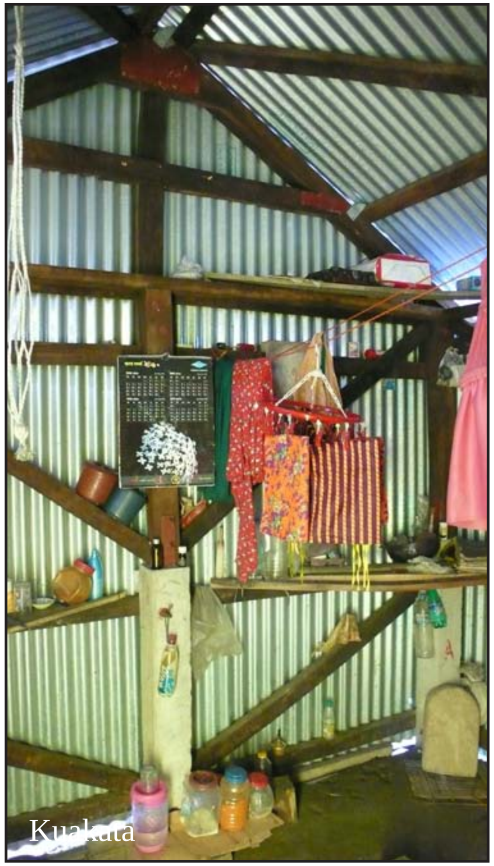


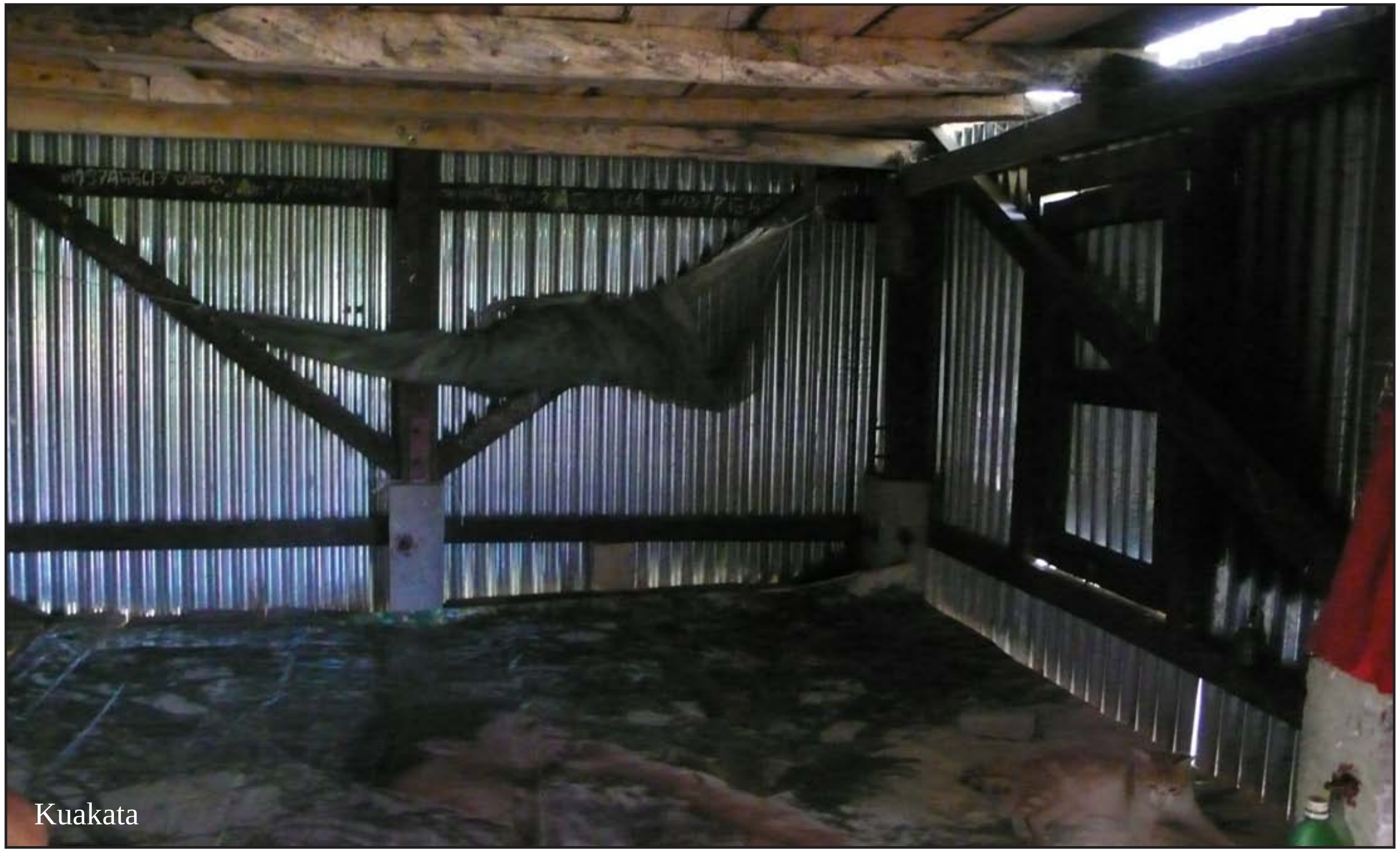
Kuakata

Bracing avoid the structure to bend.

- Protection against strong winds -

long wall bracing

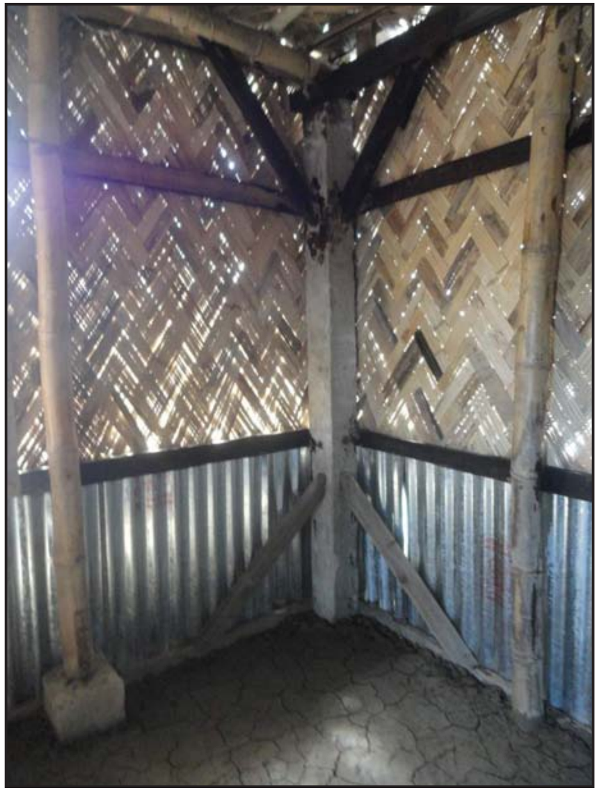


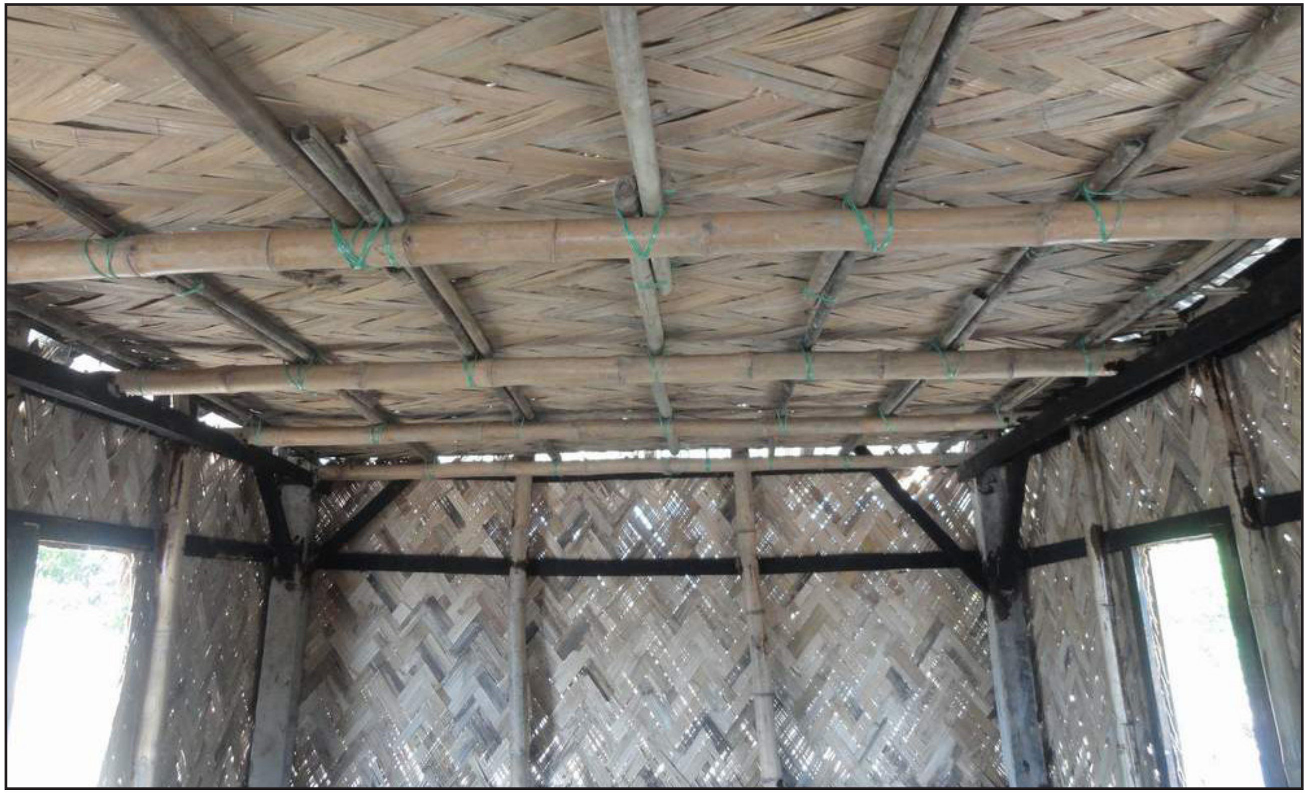


Bracing avoid the structure to bend.

- Protection against strong winds -

short bracing in the corners

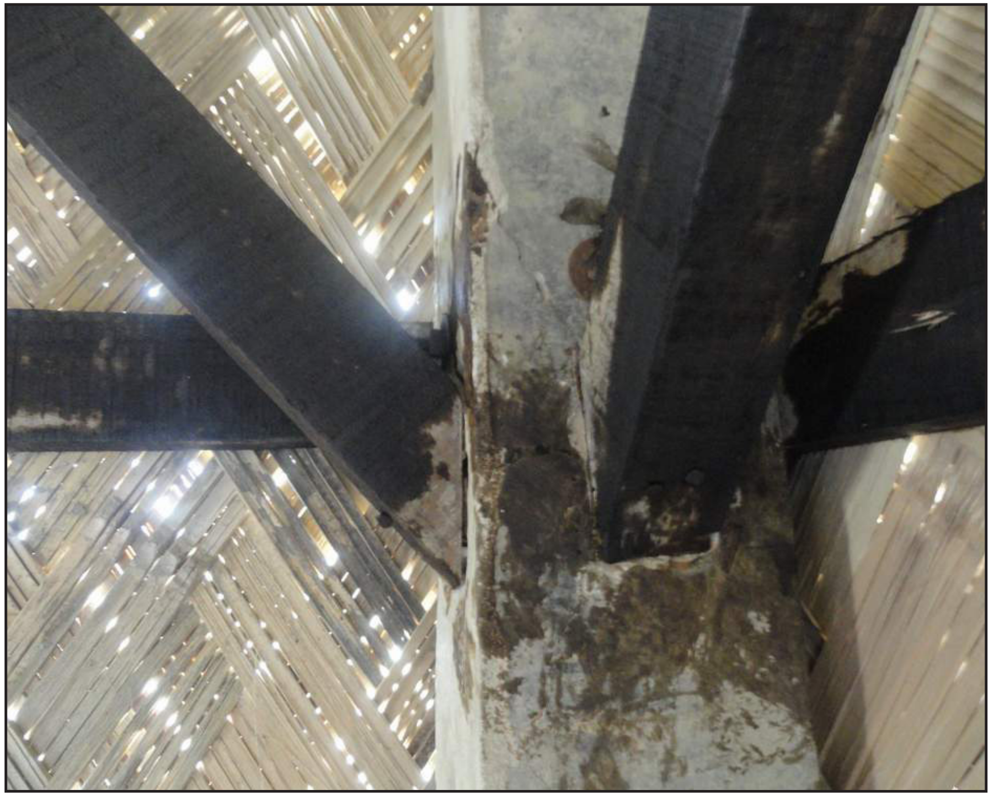


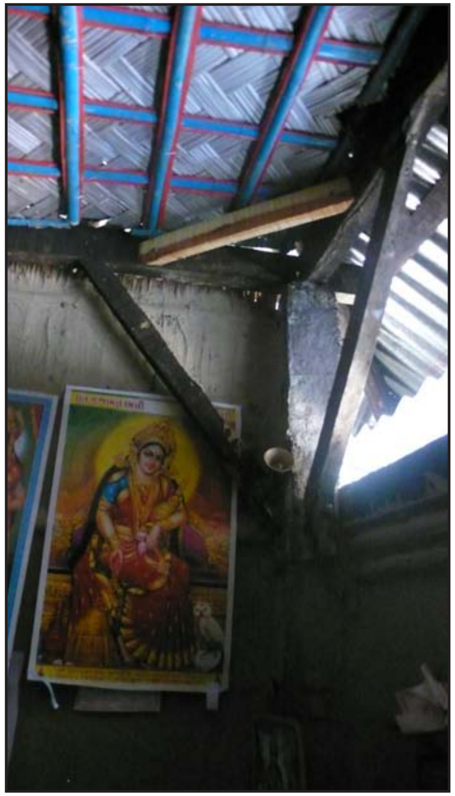


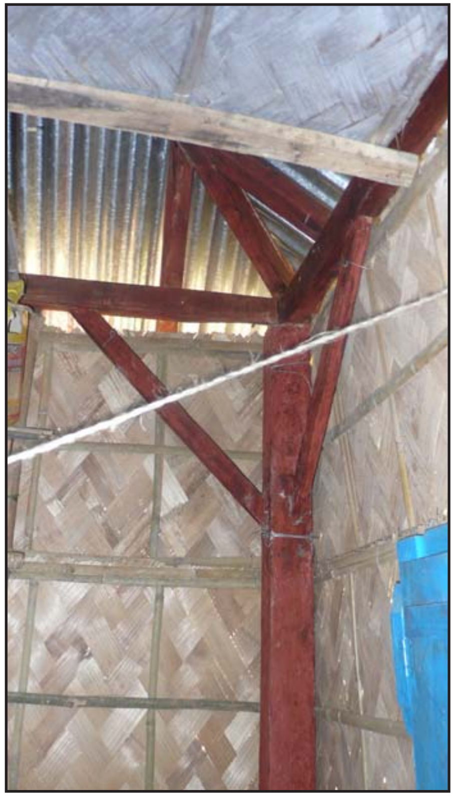
Short bracing plays the same role and can replace long wall bracing ; it is cheaper.

- Protection against strong winds -

short bracing in the corners



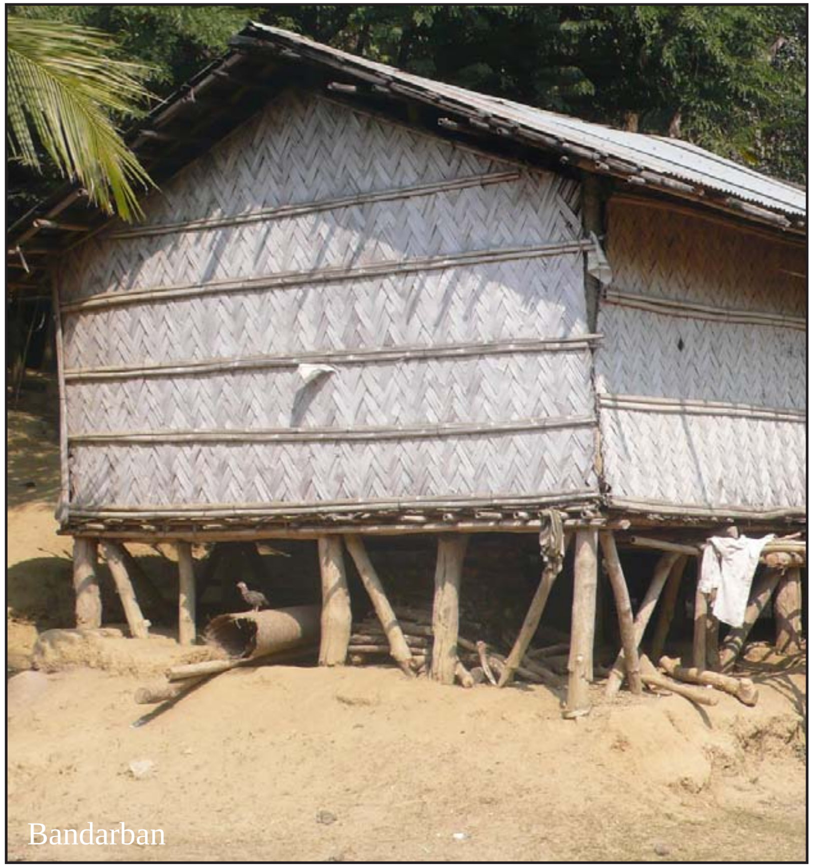




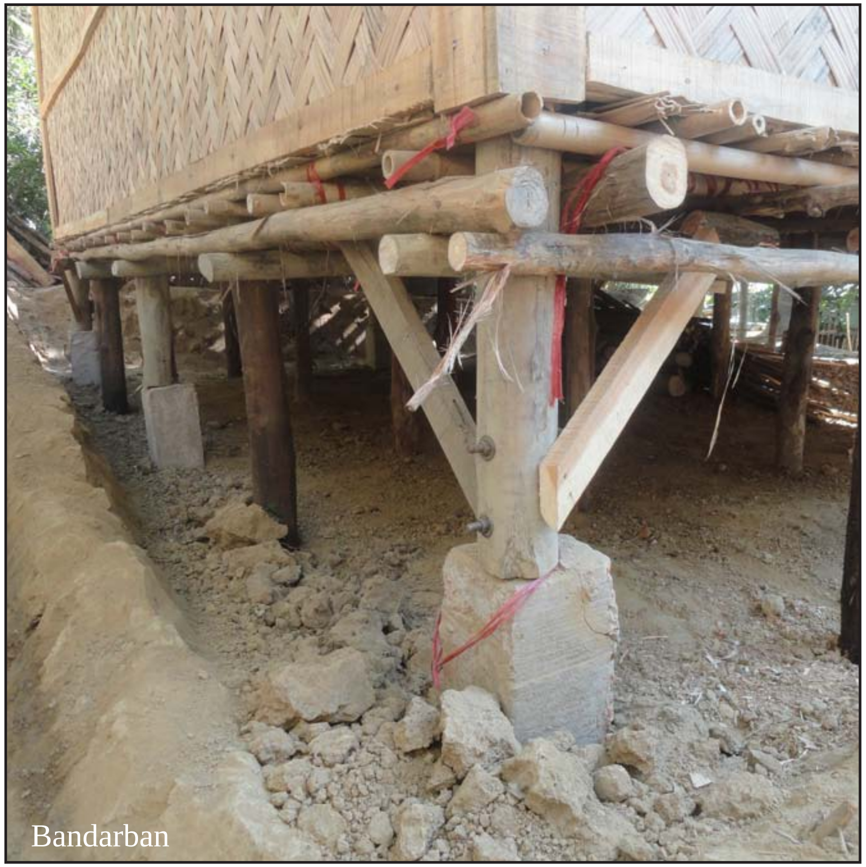
Short bracing plays the same role and can replace long wall bracing ; it is cheaper.

- Protection against recurrent floods -

stilts bracing



Bandarban

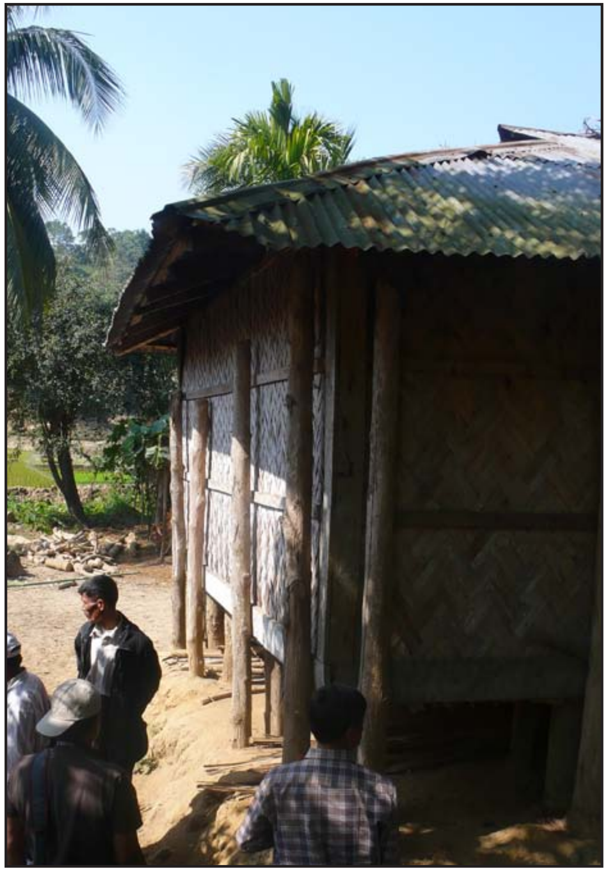


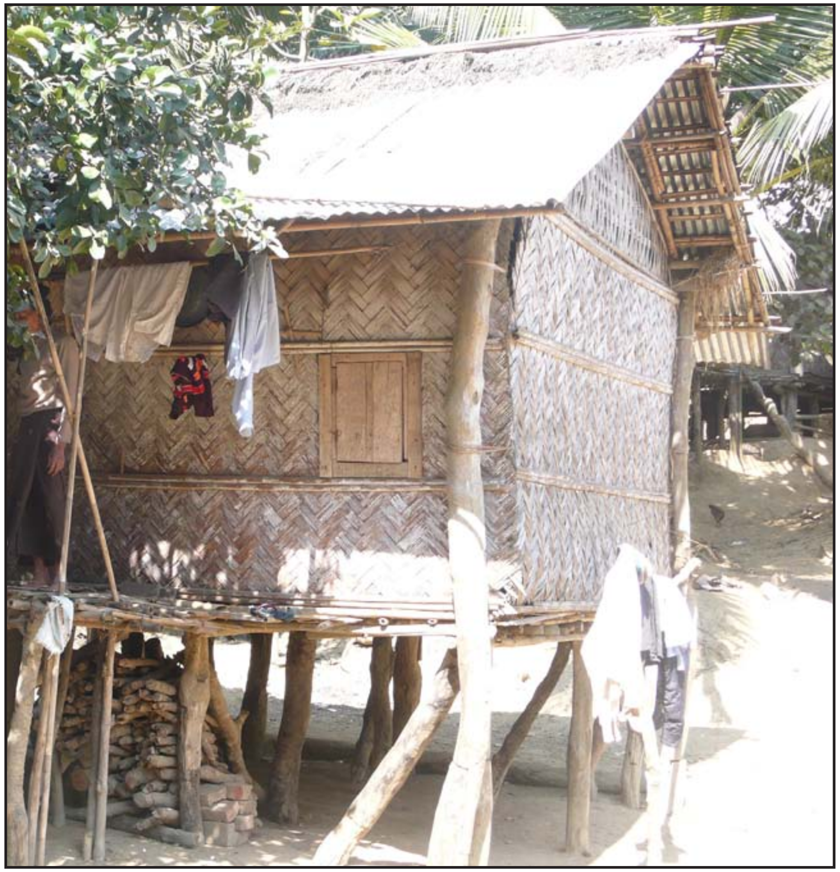
Bandarban

Stilts bracing plays the same role as for the pole bracing, it avoids the house to bend down.

- Protection against recurrent floods -

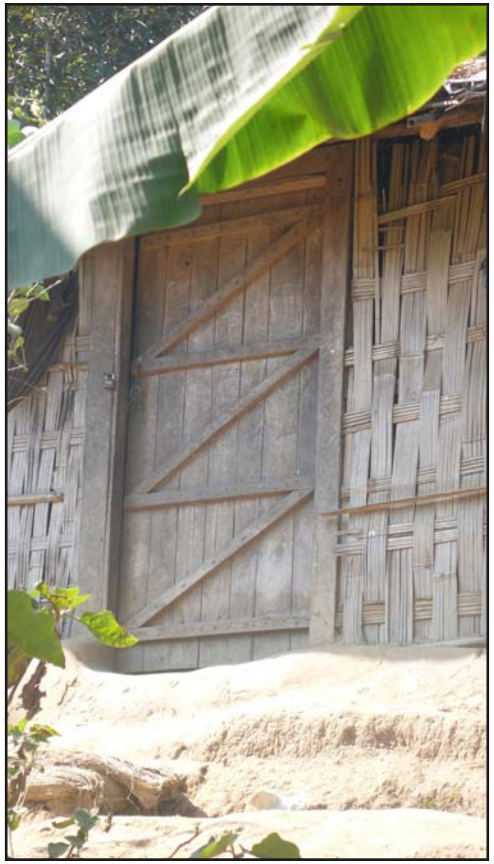
reinforcement of stilt walls with long poles





- Protection against strong winds -

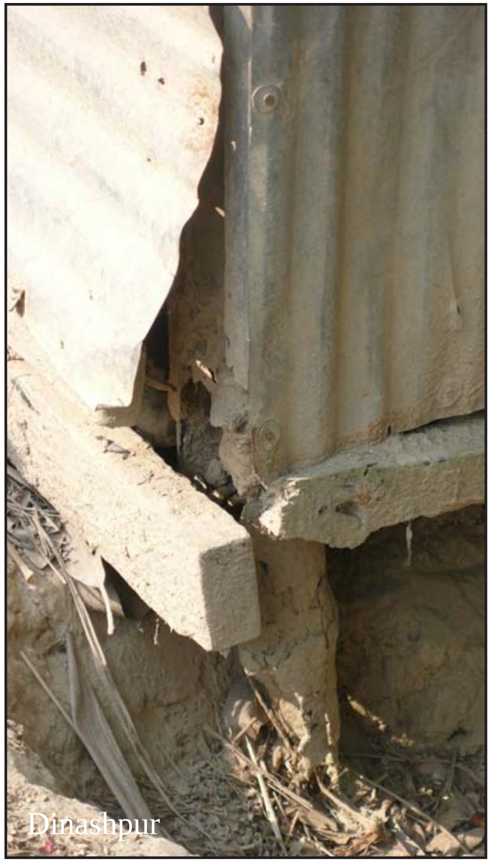
door bracing

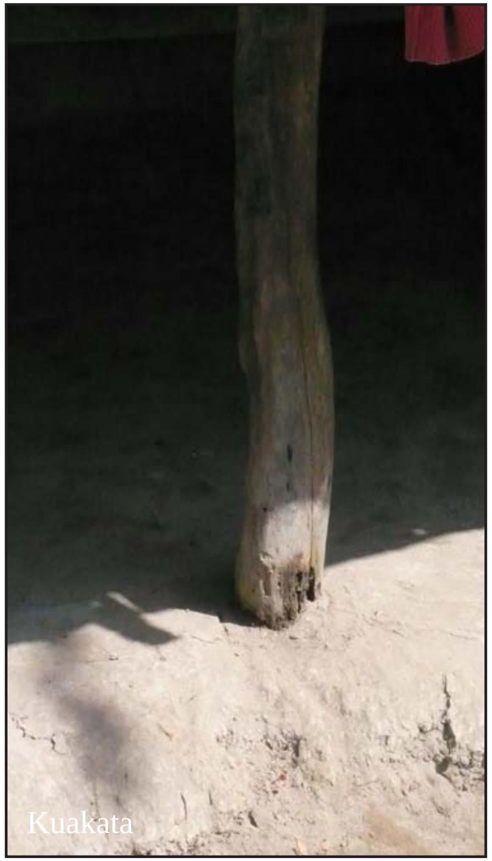


Structure bracing prevents the door to twist, affecting a proper closing so.

- ROTTING OF WOODEN POLES -

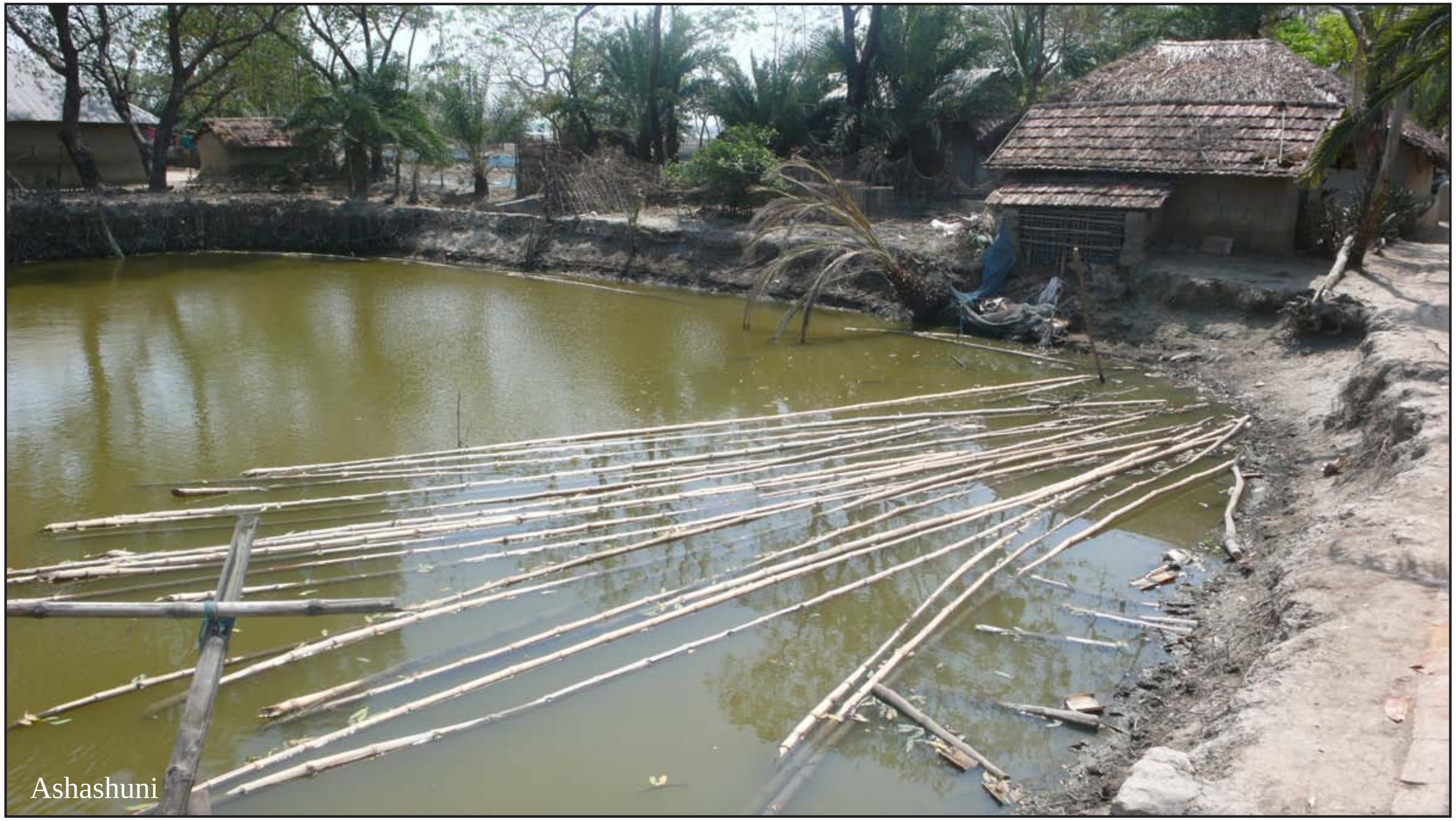
Poles planted directly into the wet ground





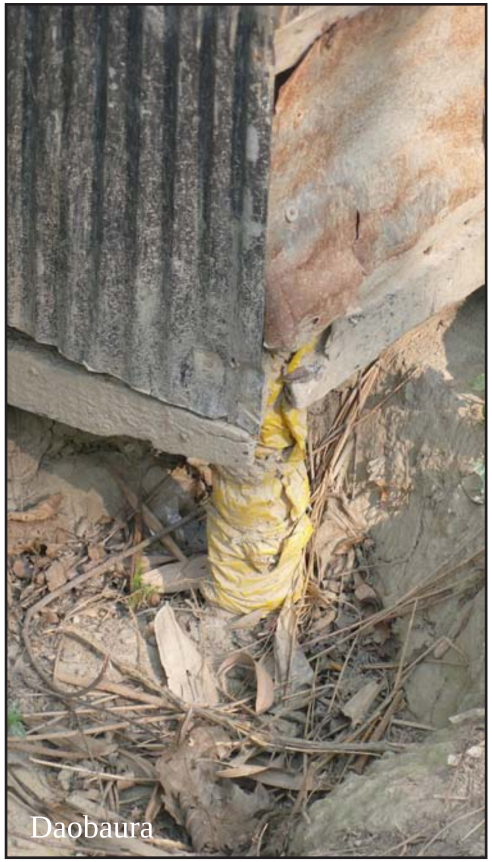
- Protection against rotting of wooden poles -

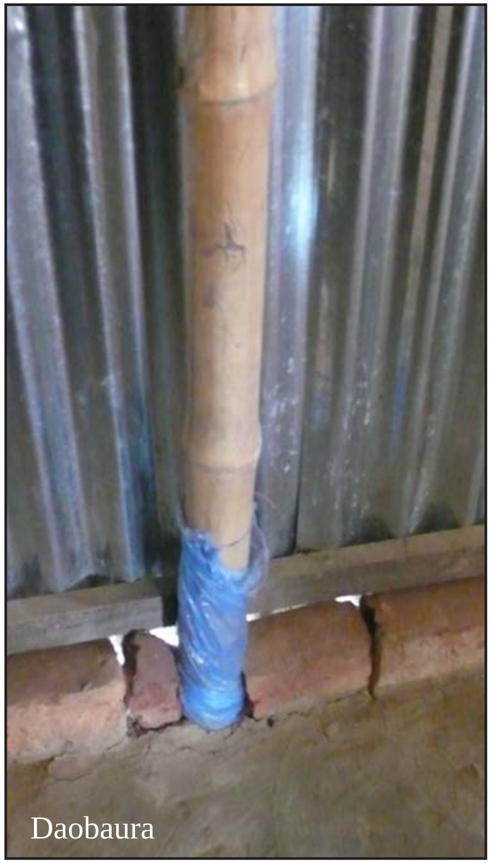
bambous protection process

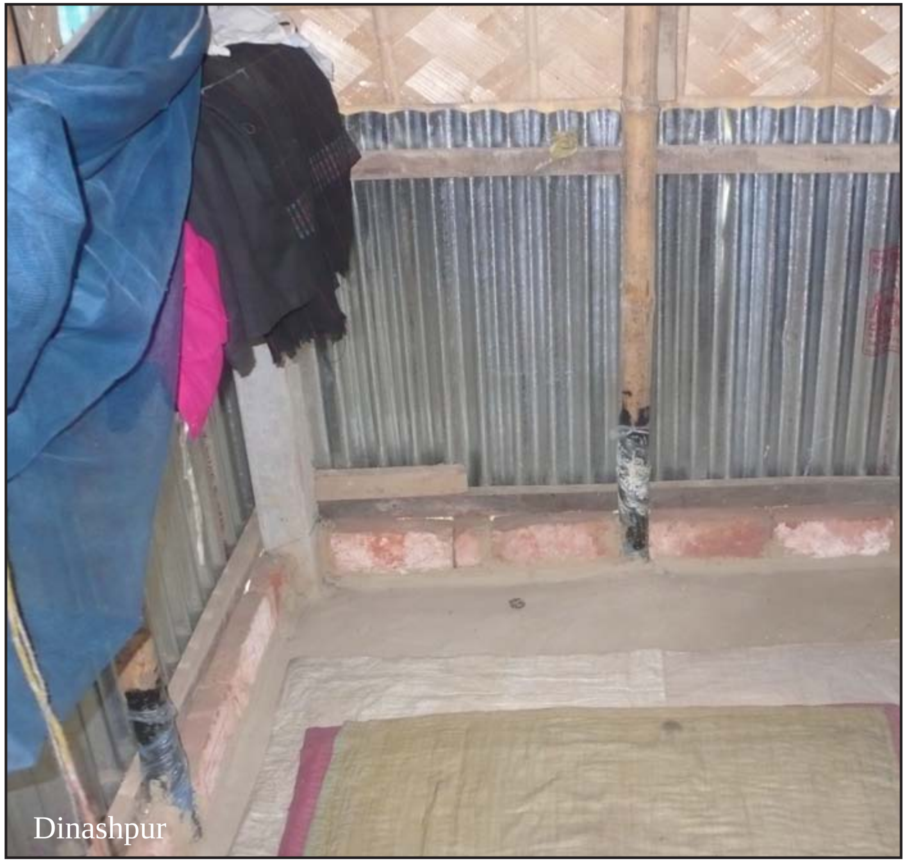


- Protection against rotting of wooden poles -

pole base wrapped up in plastic


Daobaura

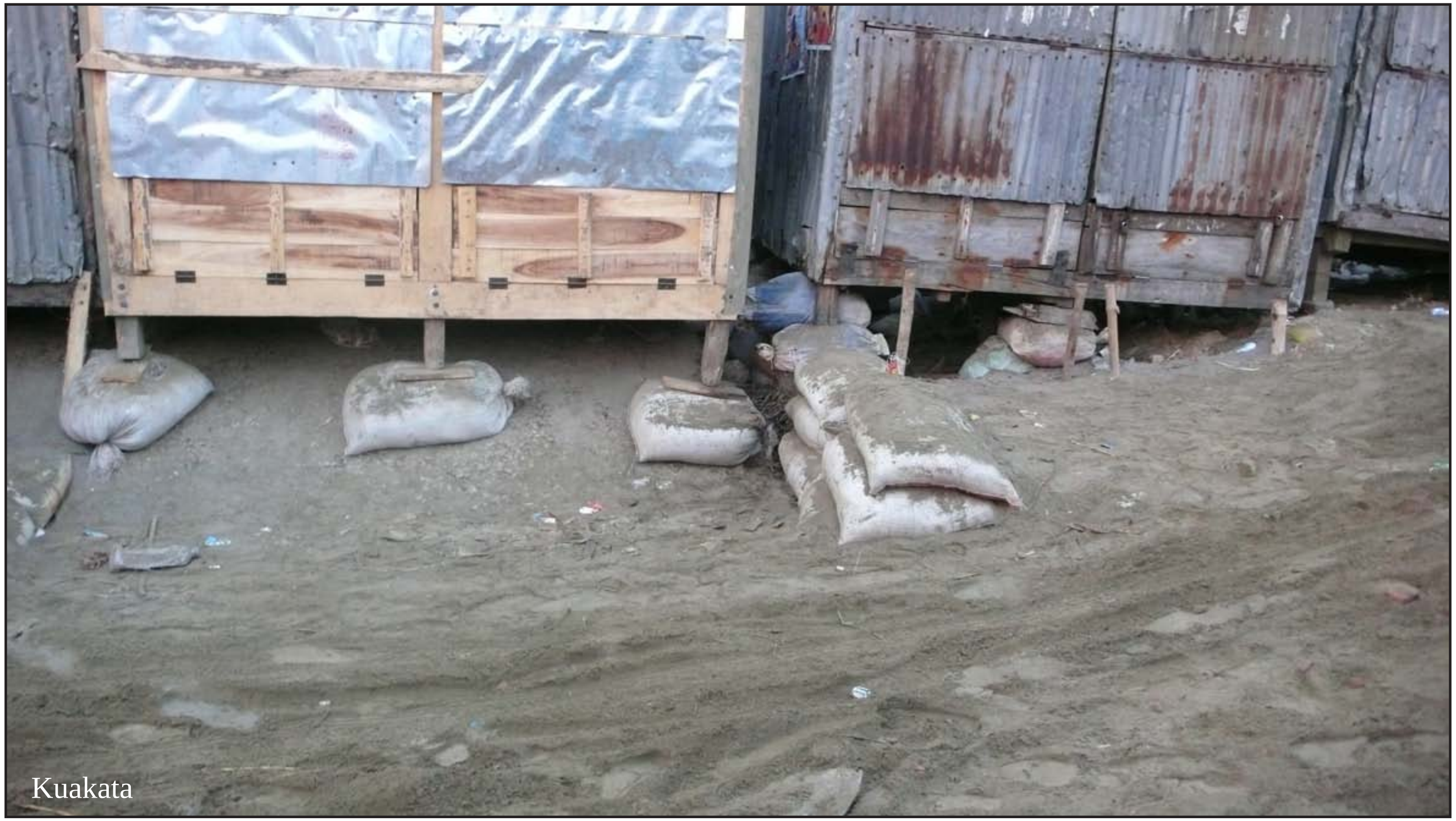

Daobaura


Dinashpur

Plastic sheet avoids contact between the wood and ground moisture.

- Protection against rotting of wooden poles -

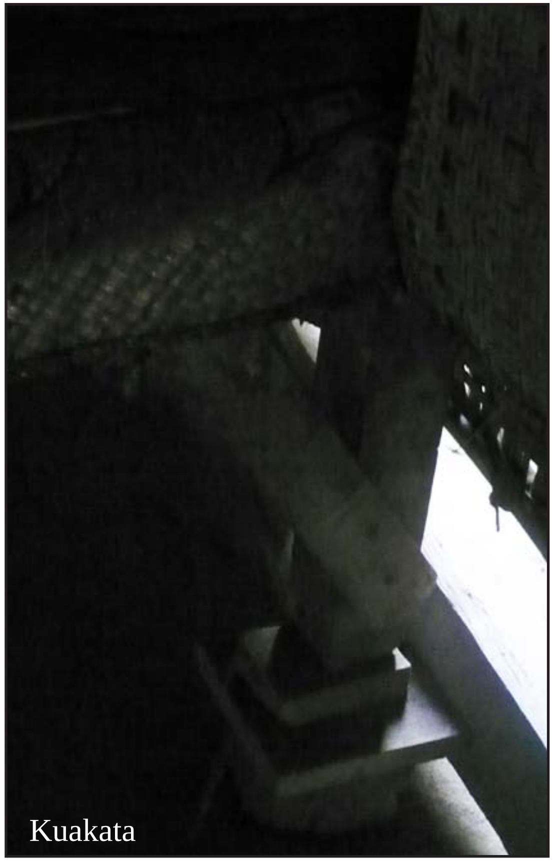
local foundation under poles

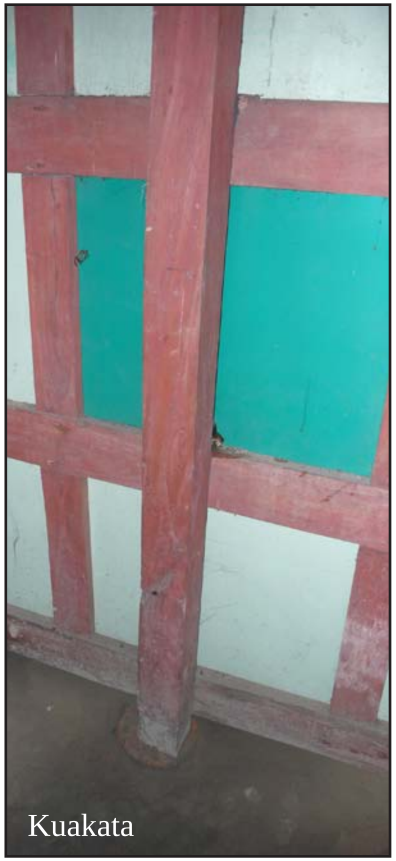


Poles are raised up from the ground and from its humidity.
This temporary solution may create some issues : the lack of a ground anchorage, instability and risk of water stagnation on the plastic, meaning in contact with the wood.

- Protection against rotting of wooden poles -

wooden poles isolated from soil moisture (katla)


Kuakata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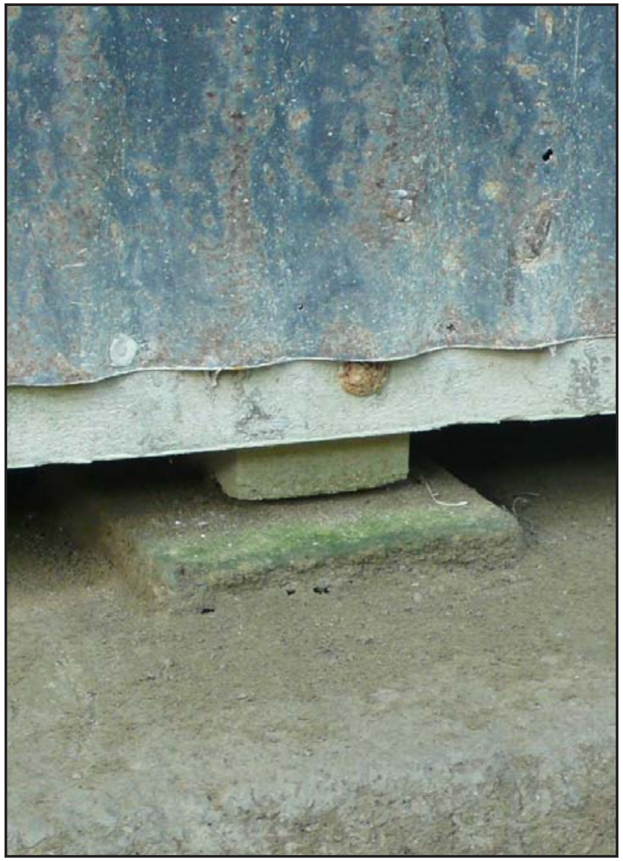
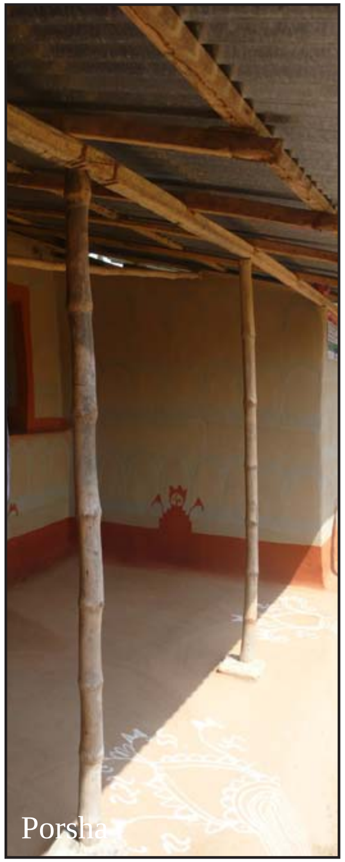
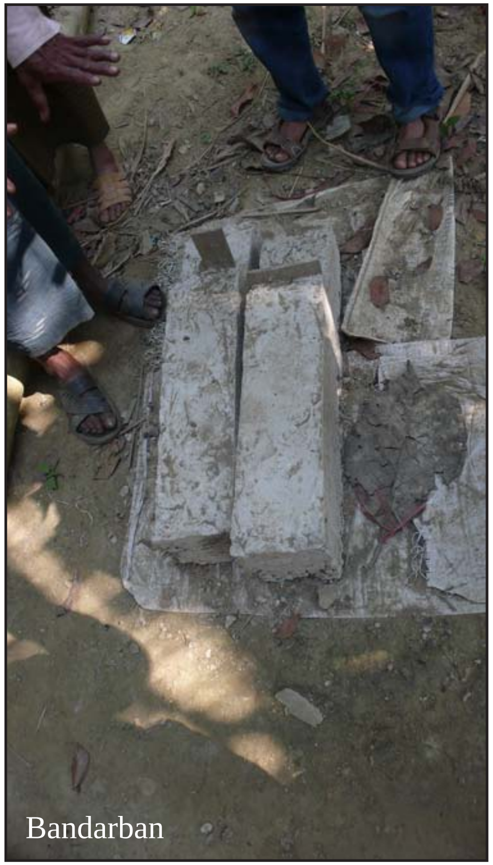


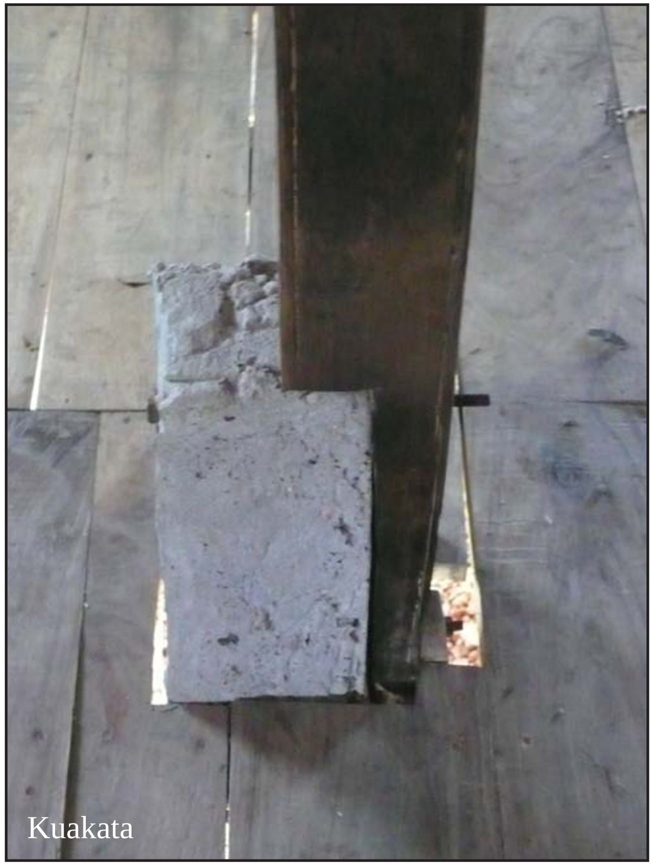

Porsha

Katla : house columns are placed on a water proof element (or on a stack of them).

- Protection against rotting of wooden poles -

piles protected from ground humidity (katla)


Bandarban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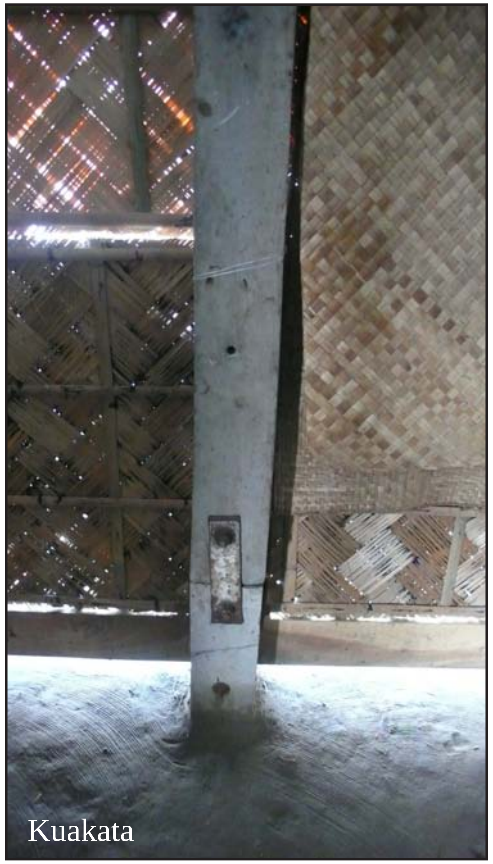
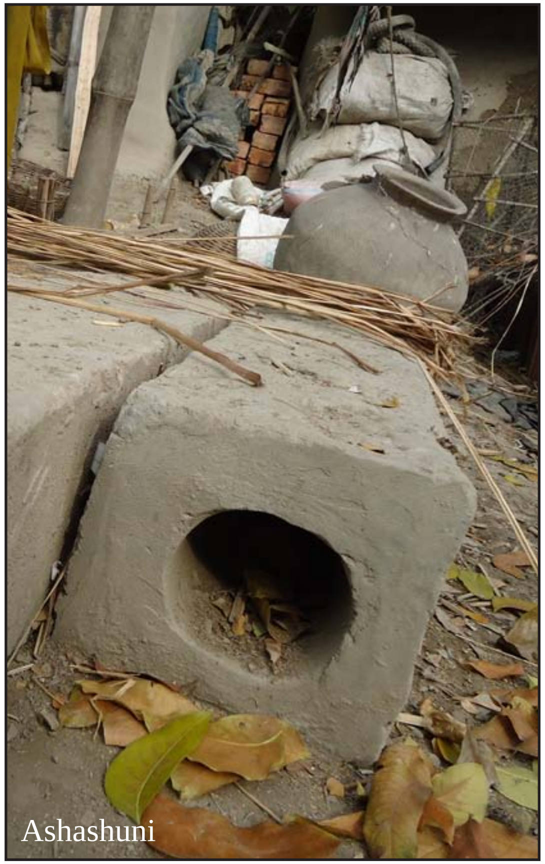

Kuakata

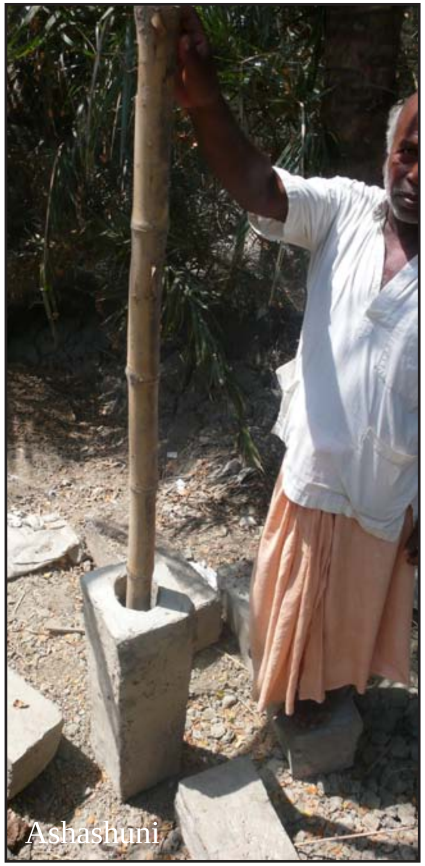
Katla : prefabricated concrete elements. Wooden poles are then installed on horseback and fixed on water proof structural element.

- Protection against rotting of wooden poles -

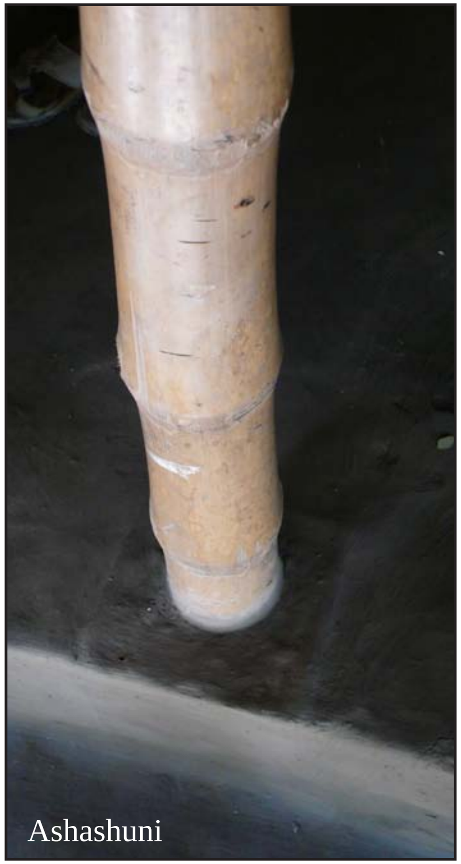
piles protected from ground humidity (katla)



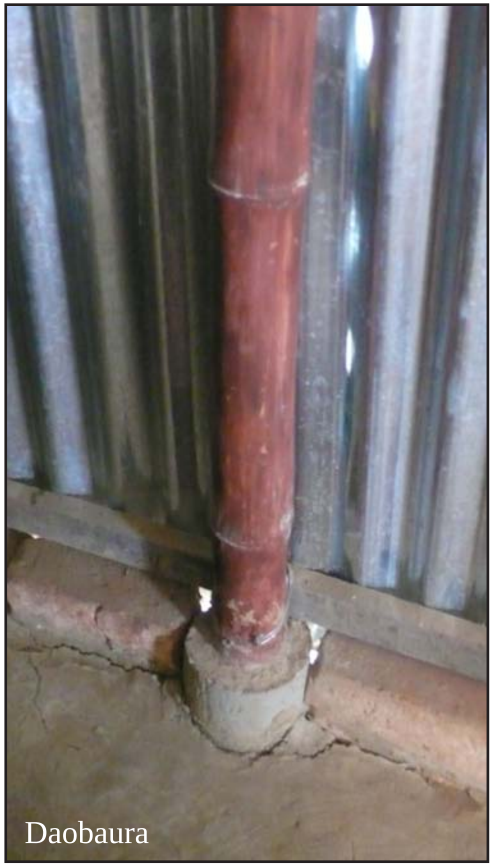
Ashashuni



Ashashuni



Ashashuni

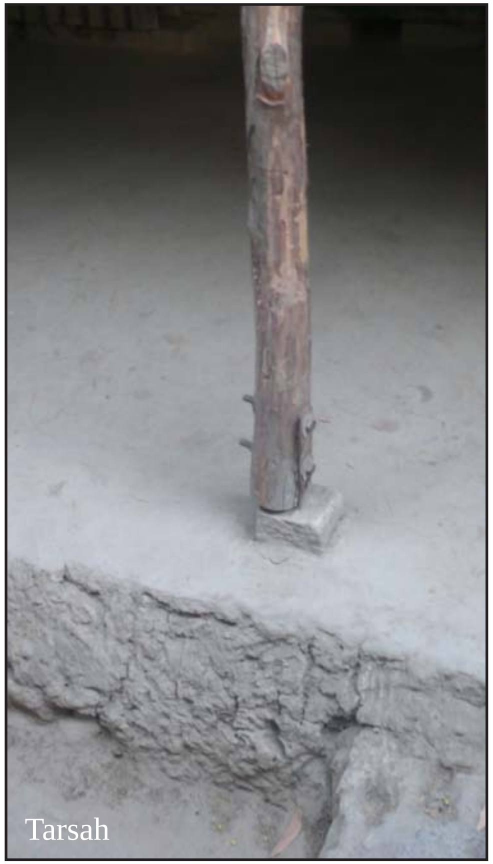


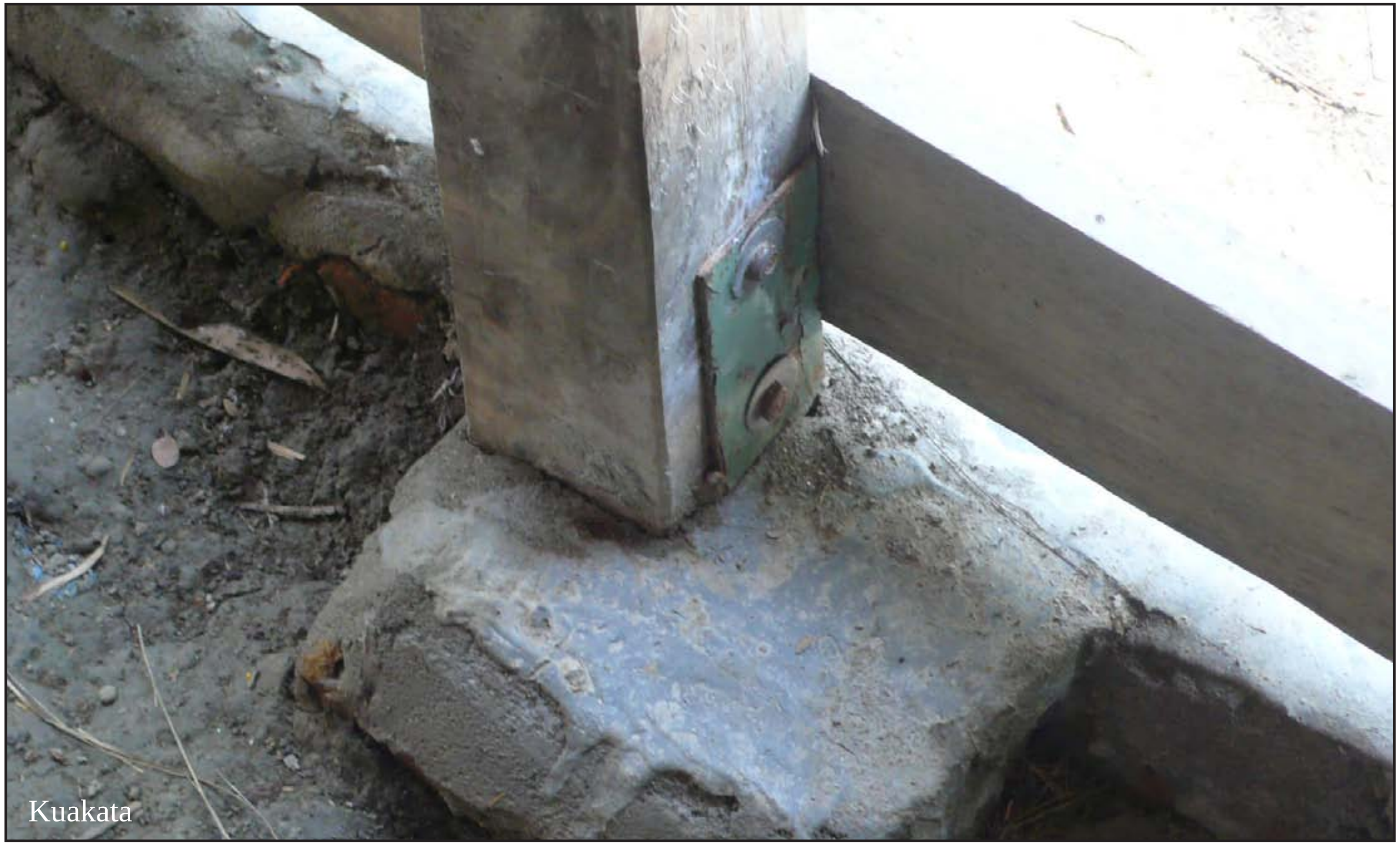
Daobaura

Katla : prefabricated concrete hollow elements (water proof), in which are then accomodated the poles.

- Protection against rotting of wooden poles -

piles protected from ground humidity (katla)

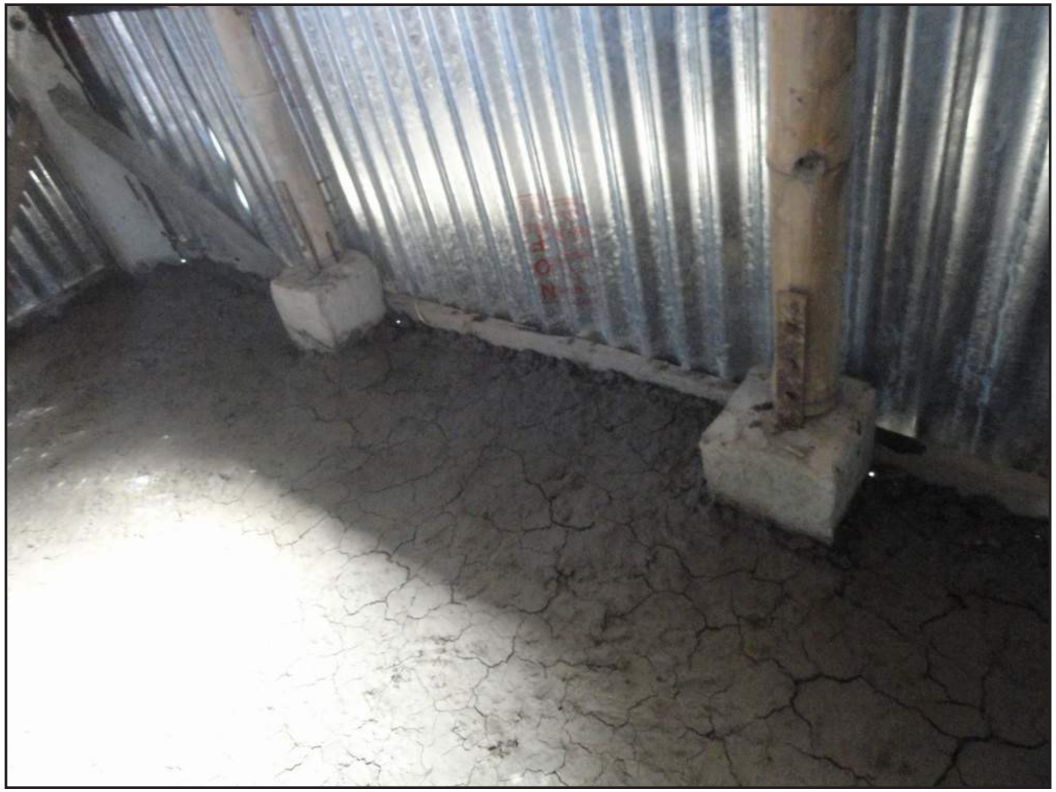

Tarsah

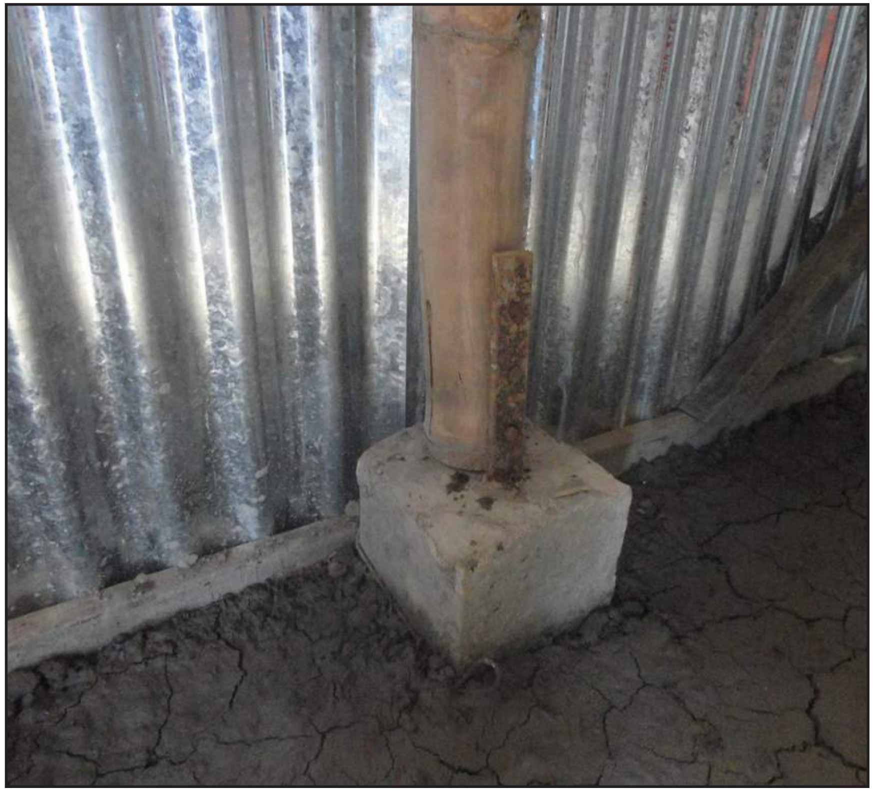

Kuakata

Katla : prefabricated small concrete elements equipped with iron bars in the center as future anchoring for wooden poles (reinforcement must be foreseen during the production). Poles are out of alignment relative to the concrete supports.

- Protection against rotting of wooden poles -

piles protected from ground humidity (katla)

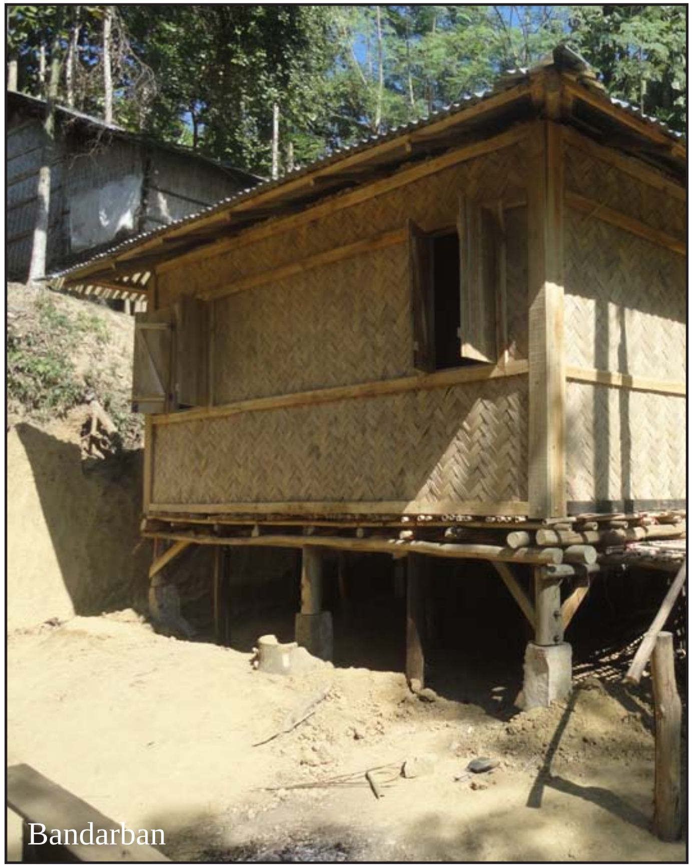


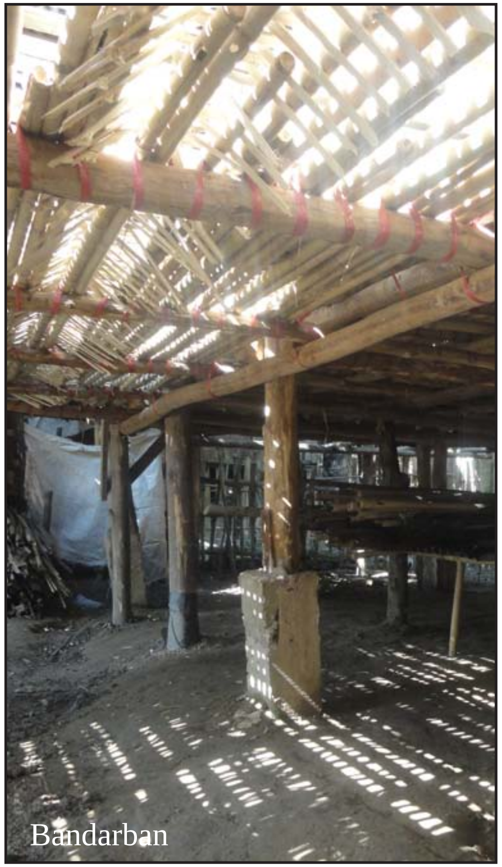


Katla : prefabicated concrete supports that are little higher than traditional one so as to reduce capillarity towards the wood. Iron bars are placed in the concrete during the production, as anchoring for poles. They will be out of alignment to allow the pole to be located exactly in the middle.

- Protection against recurrent floods -

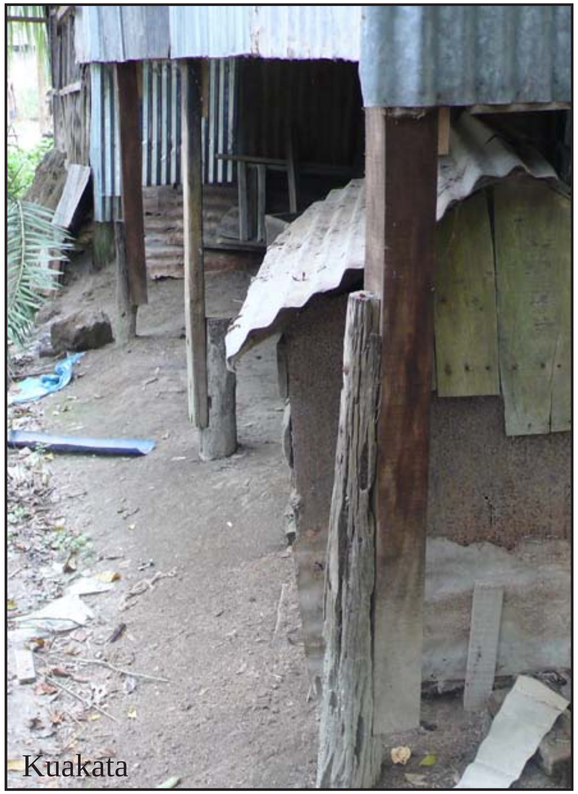
piles protected from ground humidity (katla)


Bandarban


Bandarban

- Protection against rotting of wooden poles -

poles doubling (fuse)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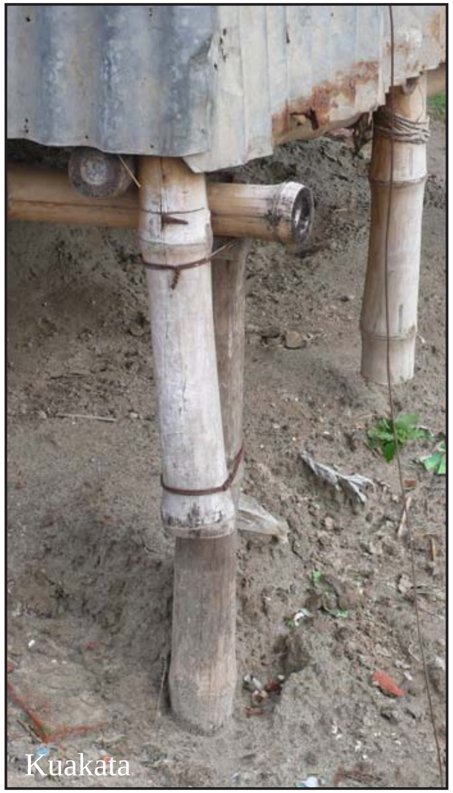
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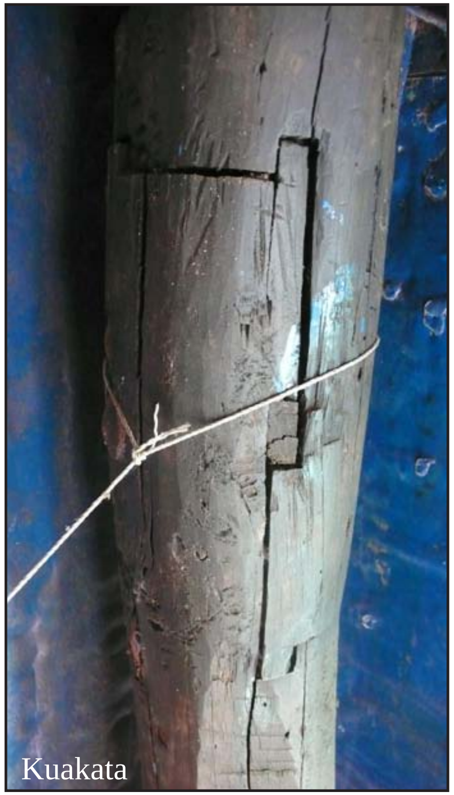
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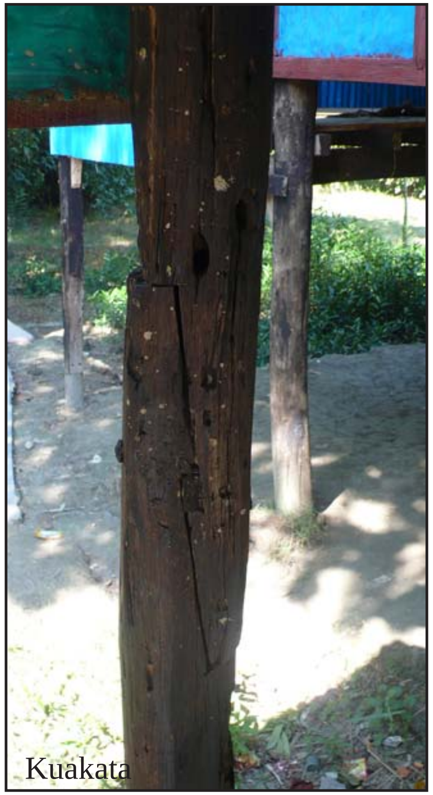
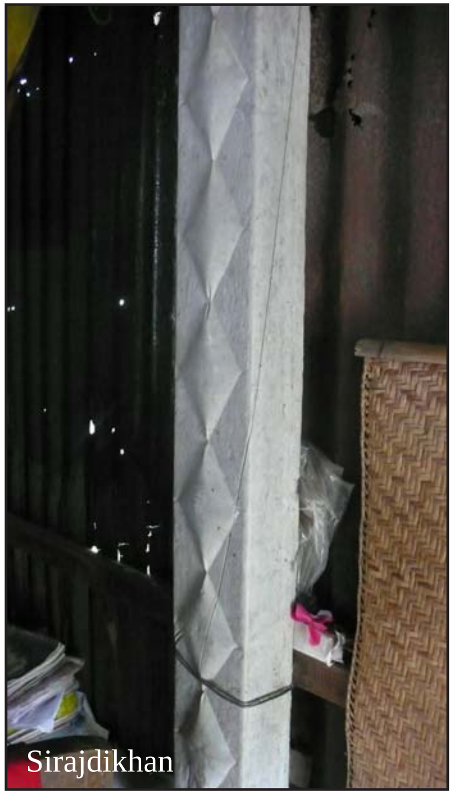

Kuakata

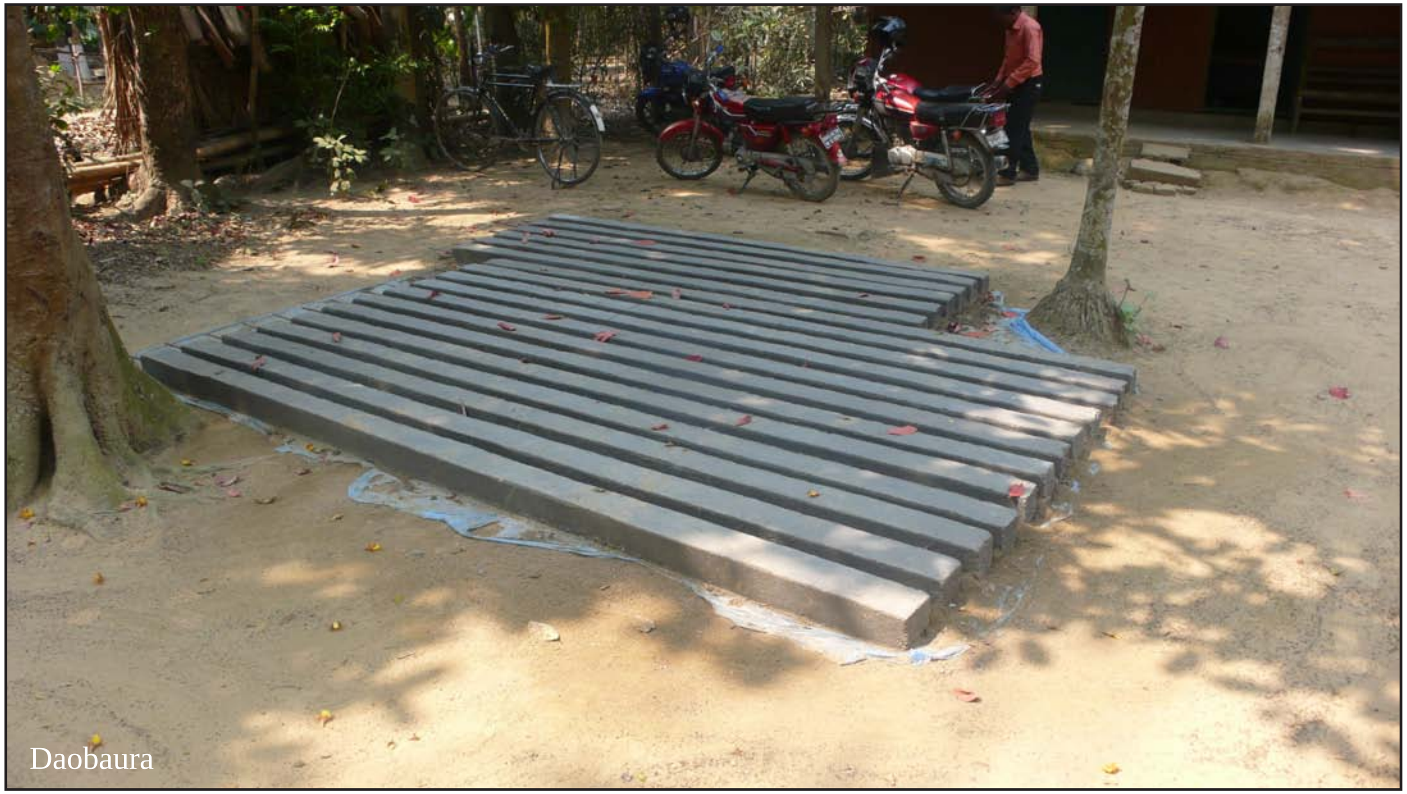
Fuse (wood poles doubling) : it allows to keep the structure away from the ground moisture. Once damaged, the elements in the ground (fuses) can be replaced without affecting the structure. In addition, shorter poles will be needed for the structure.

- Protection against rotting of wooden poles -

reinforced concrete column



Sirajdikhan

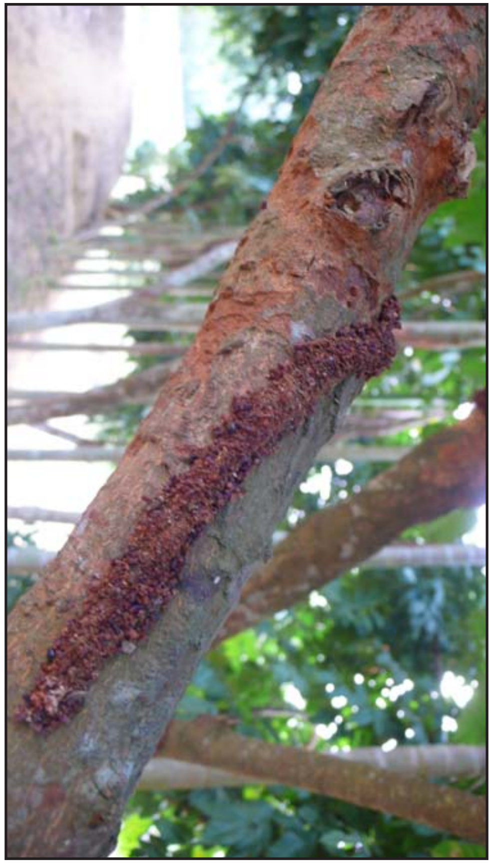


Daobaura

Reinforced concrete pillars are much less sensitive to water, mostly to repeated dipping-drying cycles. They will last longer but are often more expensive to implement.

- TERMITS -

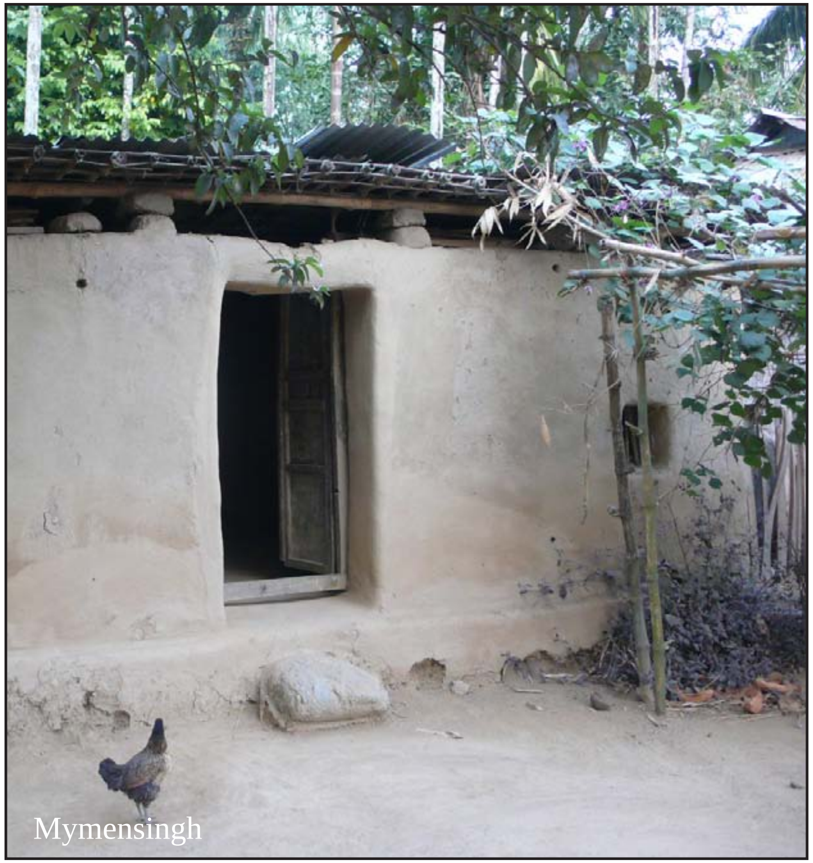
Attacks on wooden elements (poles, roof, ...)



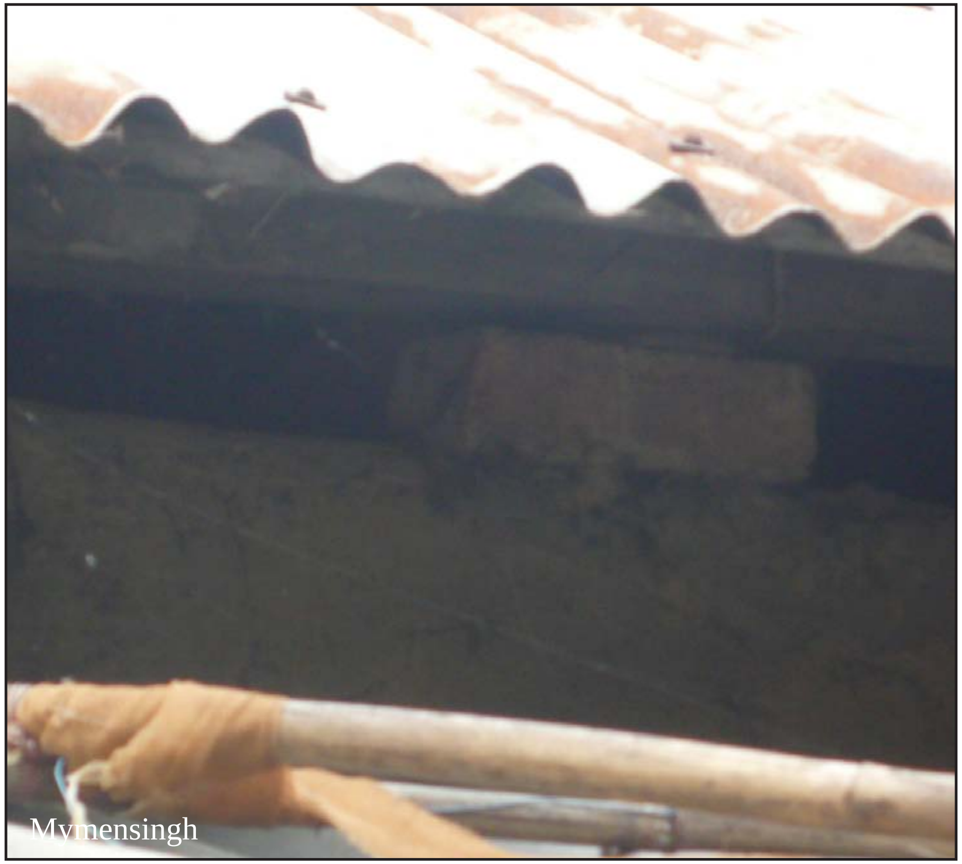
Termites usually climb through the walls or the the wood pillars to reach the wood trusses.

- Protection against termits -

roof disconnected from the wall by fired bricks



Mymensingh

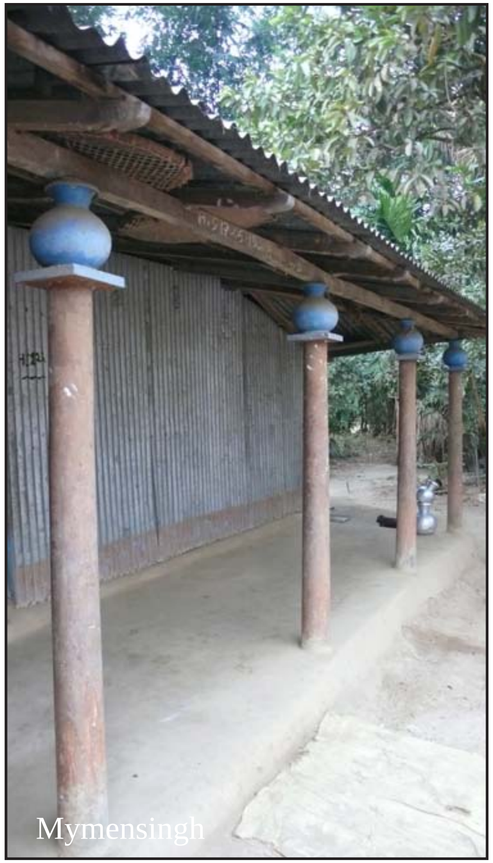


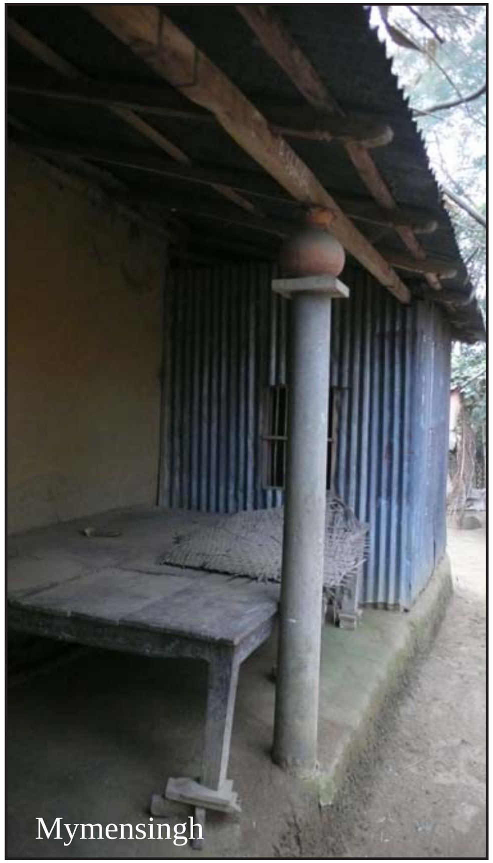
Mymensingh

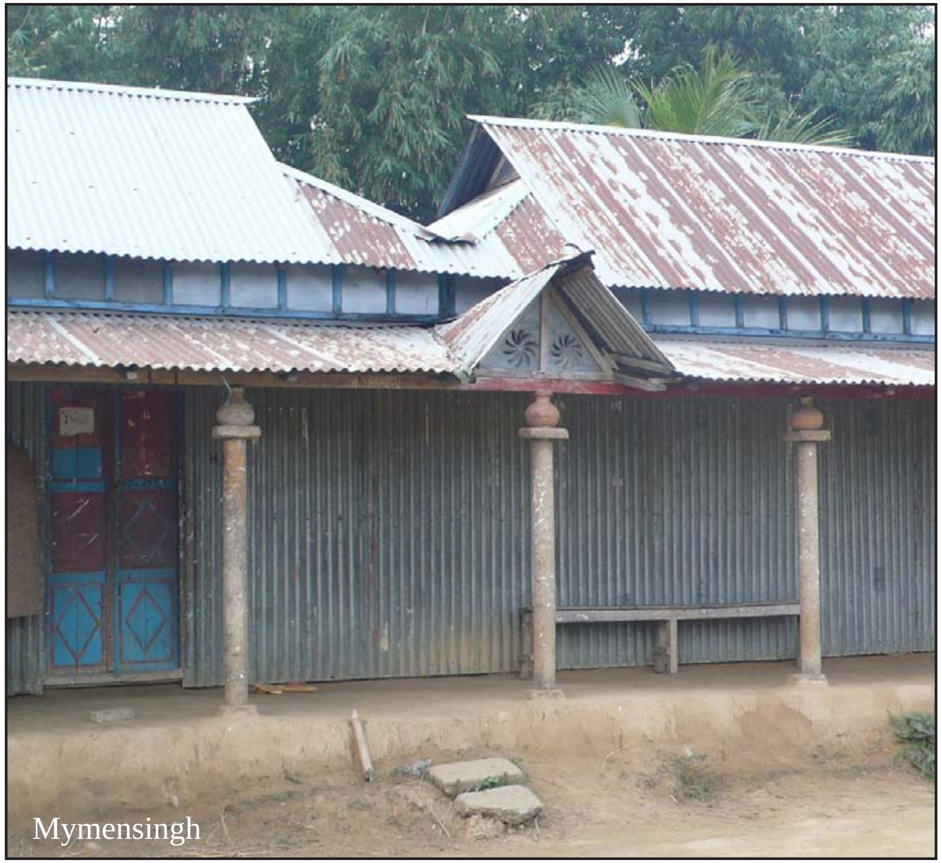
Fired bricks or other elements bear the roof structure and keep the wood (sensitive to the attack of termites) and the wall (through which termites climb up) disconnected from one another.

- Protection against termits -

roof disconnected from the wall by pottery



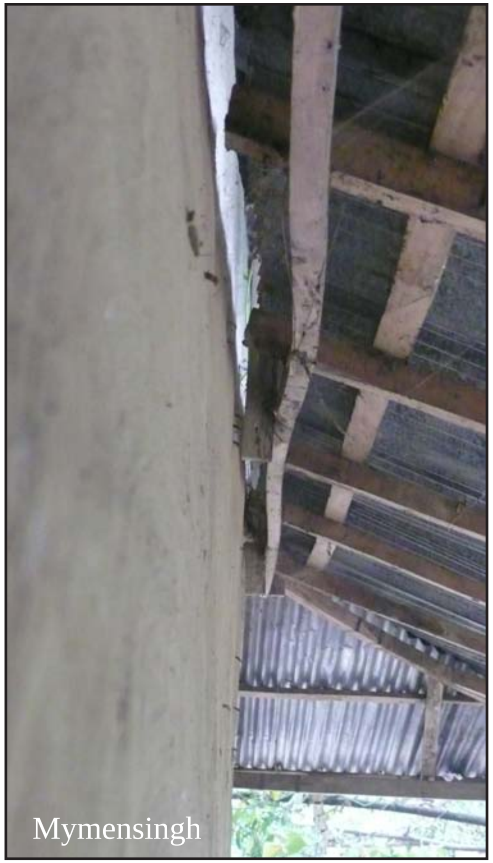


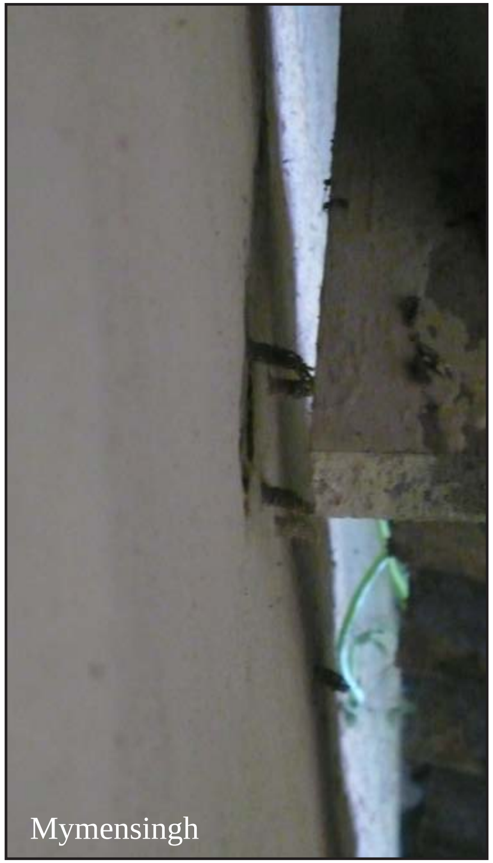


Pottery is placed on the top of wooden pillars so as to block the path to termites which climb up trough the poles.

- Protection against termits -

veranda roof disconnected from the wall

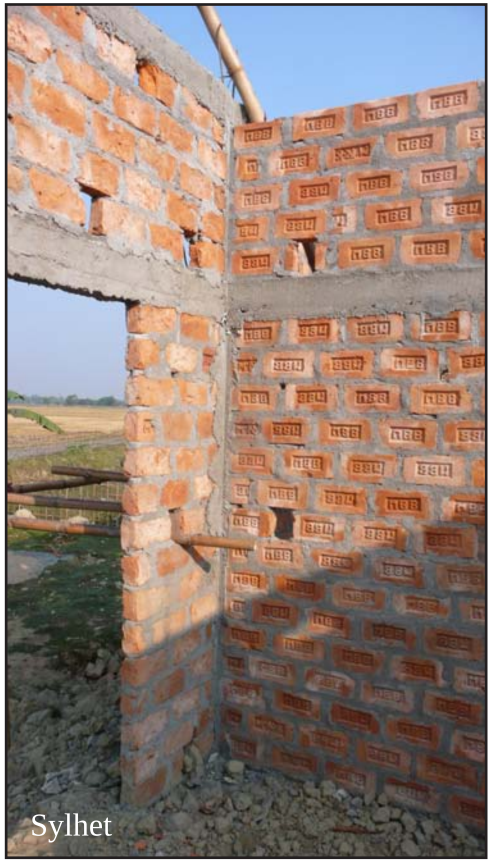


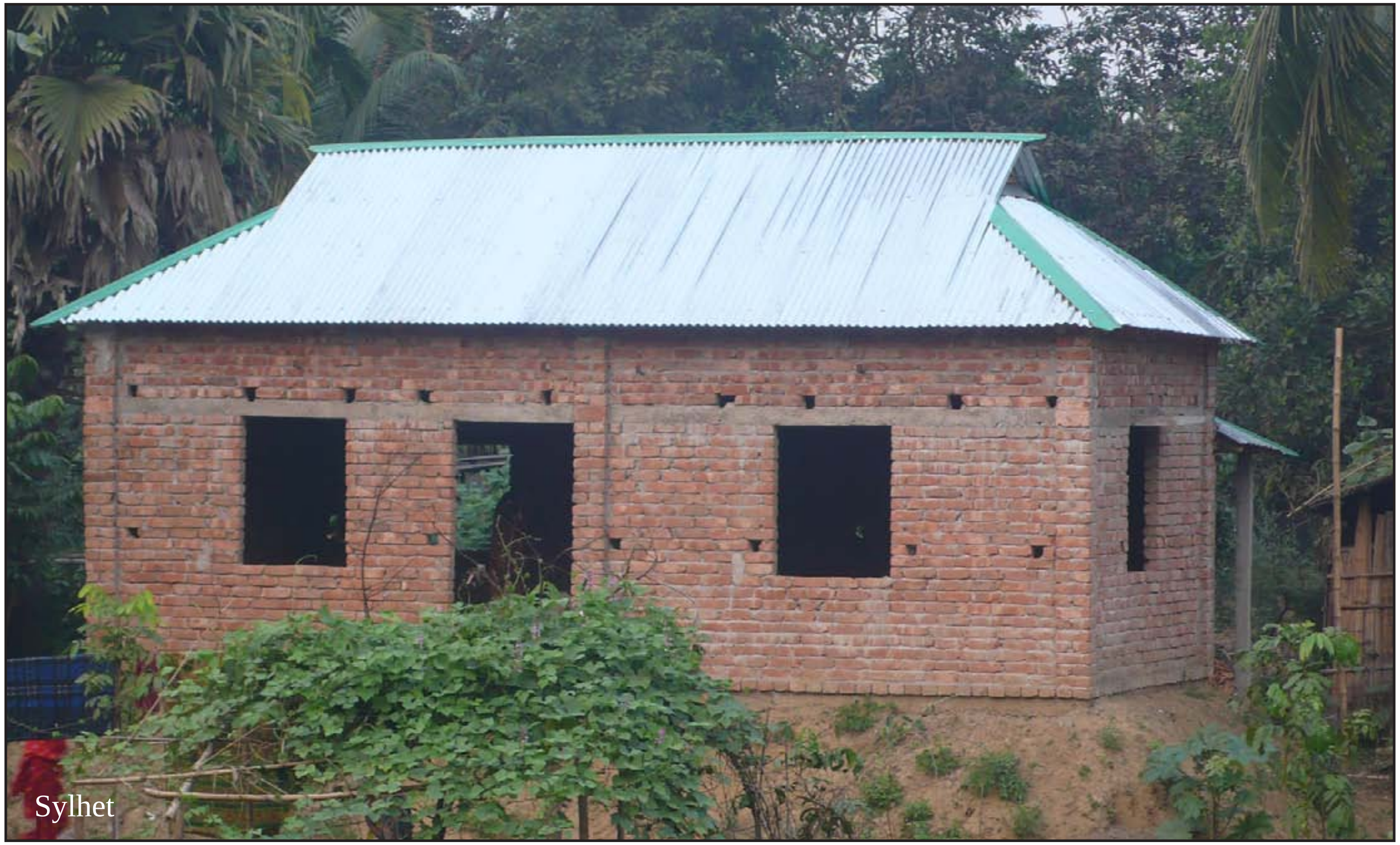


Termites exit from the wall trying to reach the wood structure of the roof, but they cannot find any bridge.

- EARTHQUAKES -

Thin and stiff walls

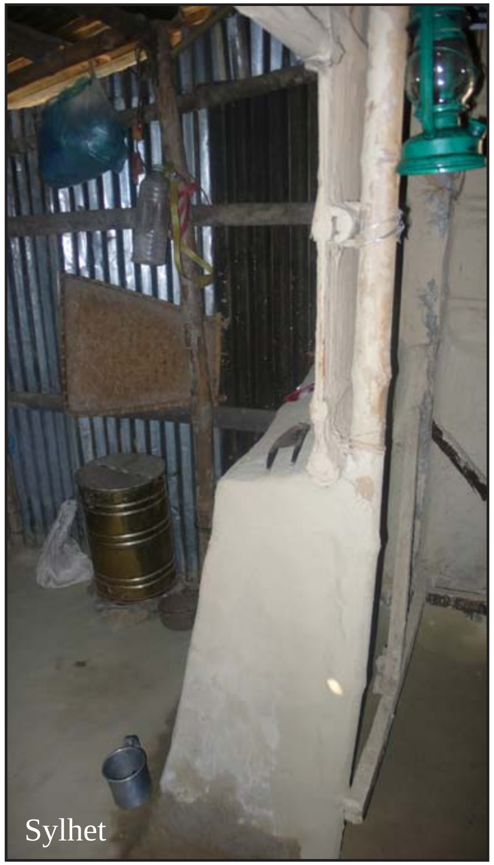




The walls in the pictures above are too thin and they lack stability and enough mass to take up seismic vibrations : they are also too rigid (they do not warp as the wood does) and they crack and fall down.

- Protection against earthquakes -

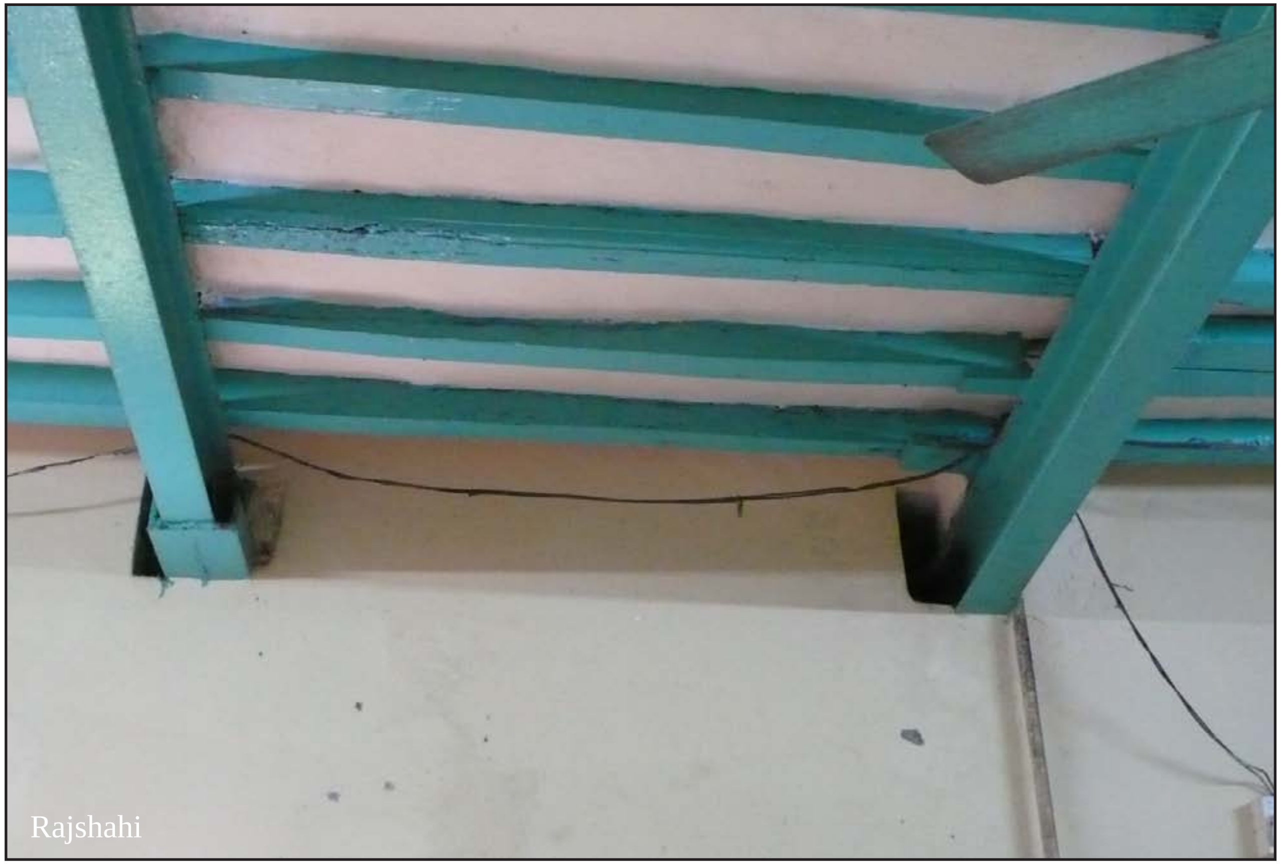
fitting wall types



The base of the wall should be thick and solid so as to take up vibrations ; the upper parts should be light and flexible to be able to follow the movement without cracking.

- Protection against earthquakes -

structure flexibility

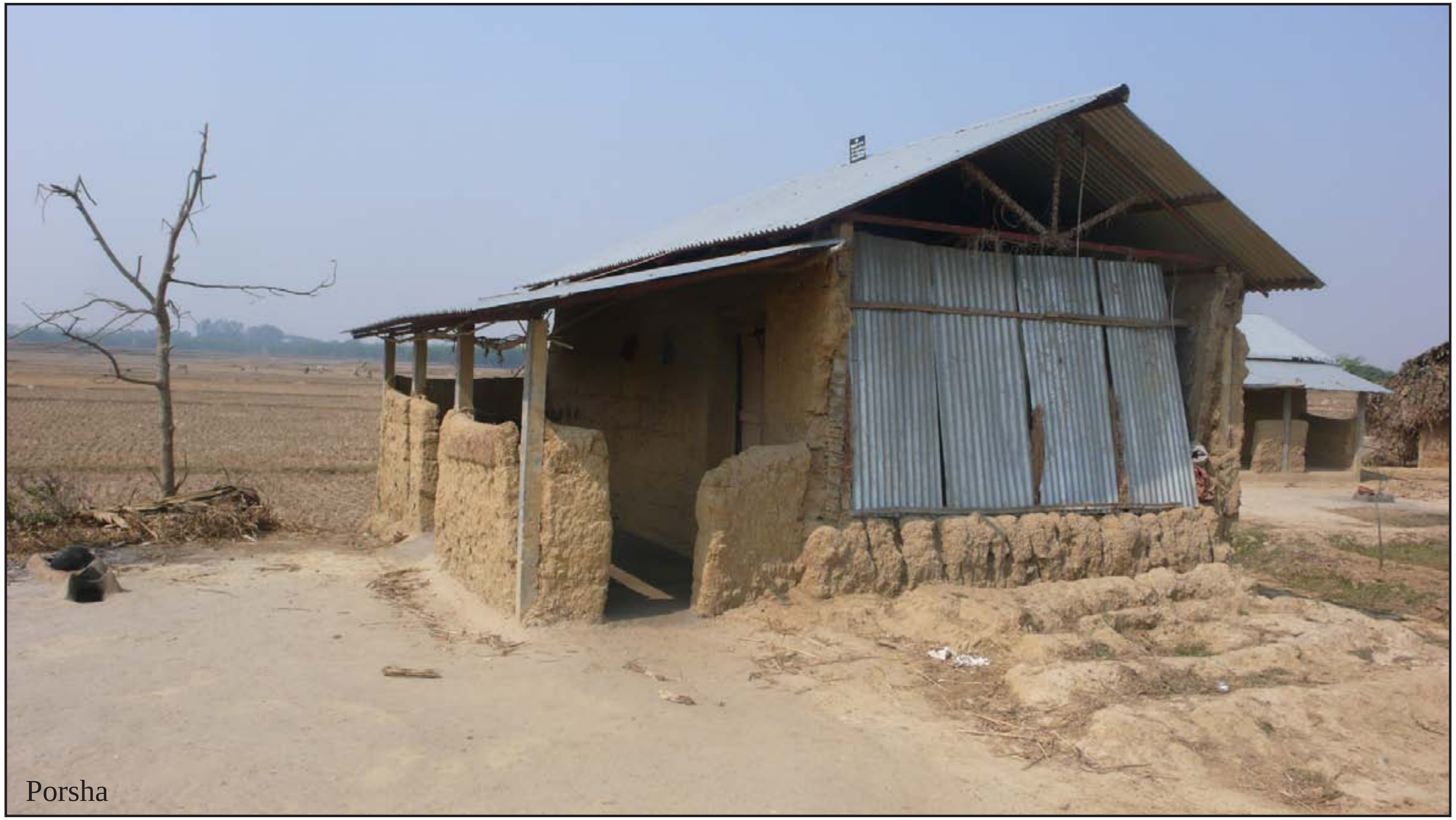


Rajshahi

Rajshahi

Flexible assembly (not stiff) of the structure to allow movements and to avoid cracks.

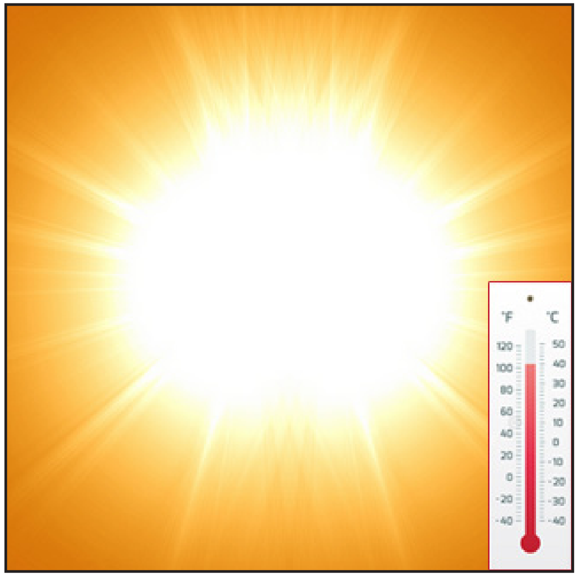
- INSTABILITY OF FILLING WALLS BETWEEN CONCRETE PILLARS -



The lack of connection between the filling and the structure leads the walls to topple over during earthquake.

- CLIMAT -

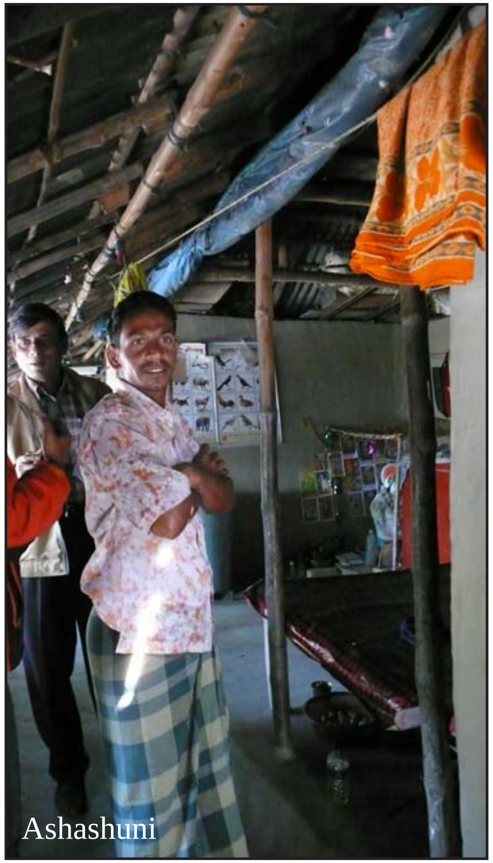
Heat and humidity



Heat and humidity cause a lack of confort inside the buildings.

- Protection against heat and moisture -

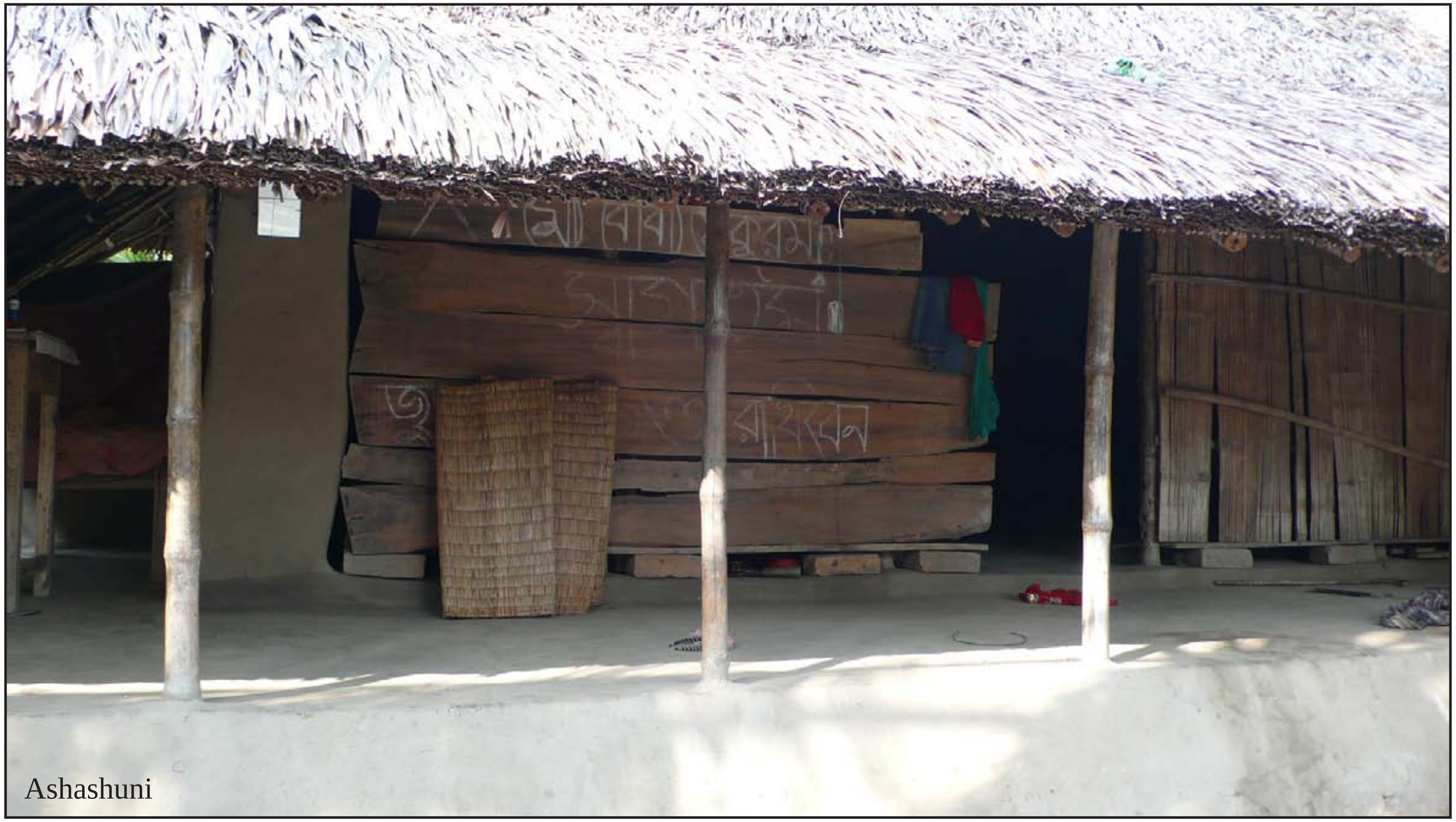
ventilation with tarpaulin partition wall



Ventilation reduces overheating and humidity so the perceived temperature (wind chill factor).

- Protection against heat and moisture -

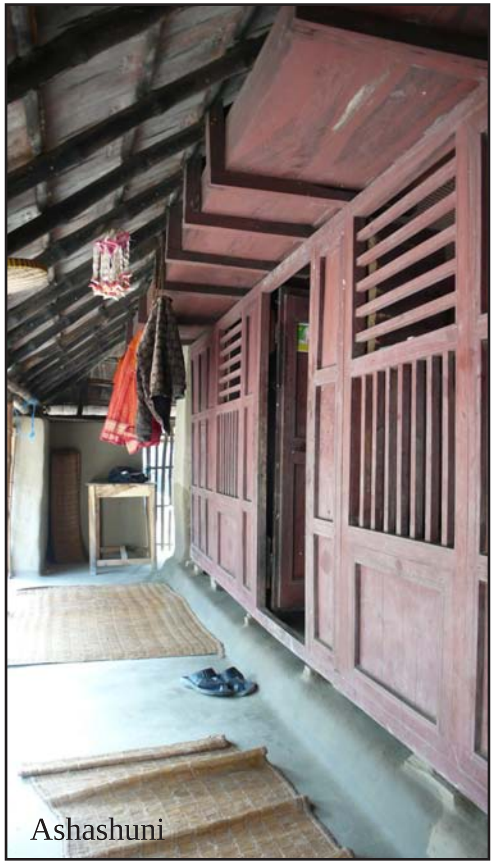
ventilation with wooden partition wall



Ventilation reduces overheating and humidity so the perceived temperature (wind chill factor).

- Protection against heat and moisture -

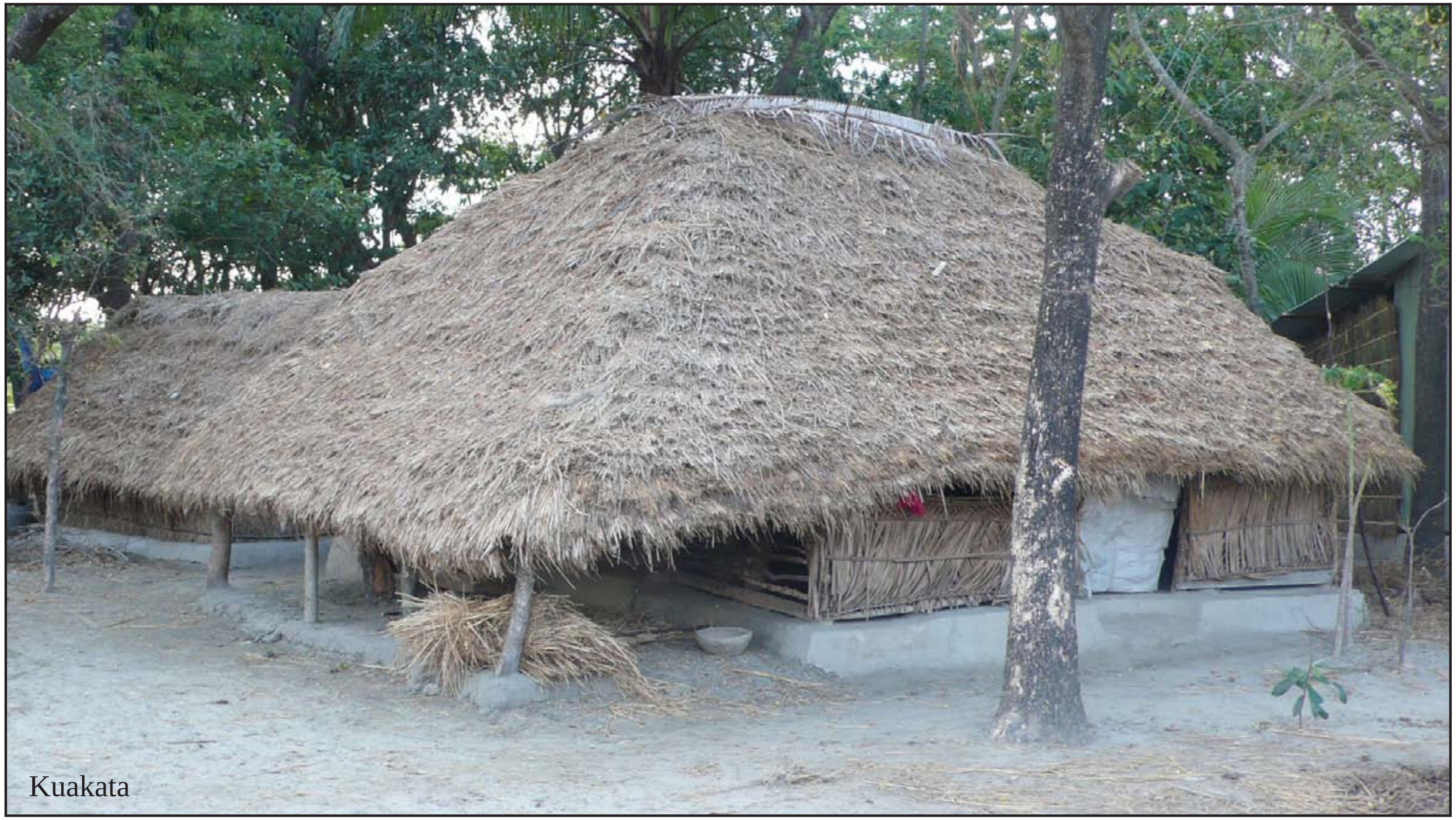
ventilation with wooden partition wall



Ventilation reduces overheating and humidity so the perceived temperature (wind chill factor).

- Protection against heat and moisture -

green roof



The green roof represents a good insulation against hot temperature and, contrary to iron sheets, it doesn’t over heat up.

- Protection against heat and moisture -

tile roof

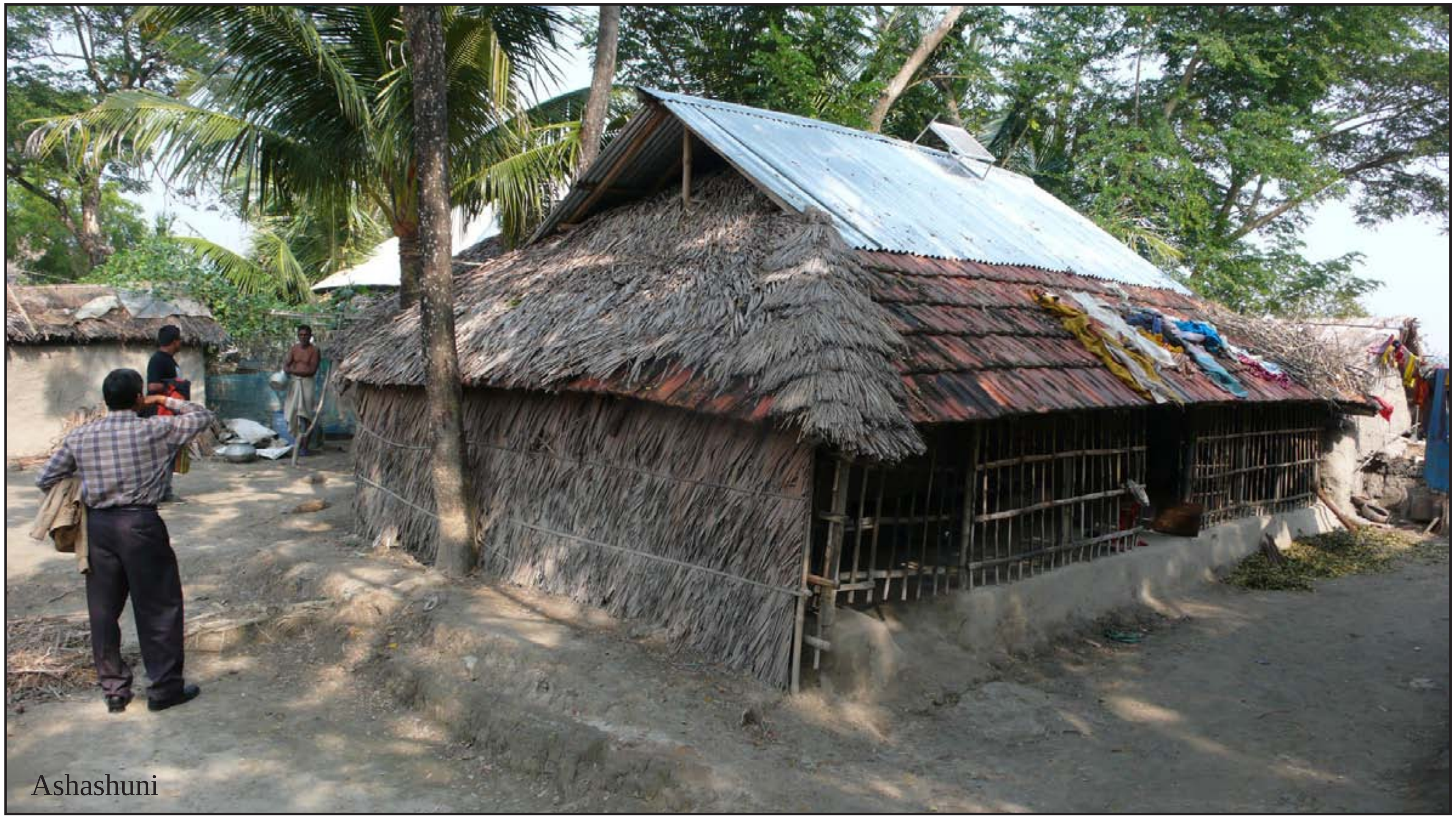
Ashashuni

Kulna

The tile roof is a quite good insulation against hot temperature and it heats up less than iron sheet under the sun.

- Protection against heat and moisture -

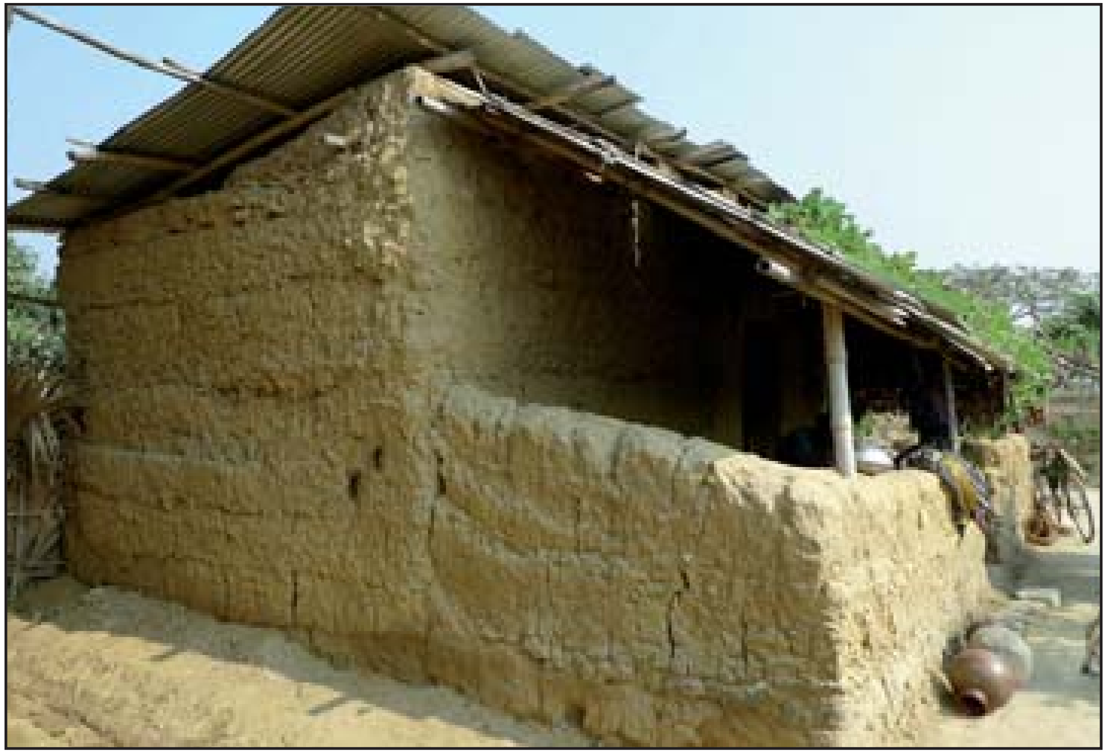
ventilated roof

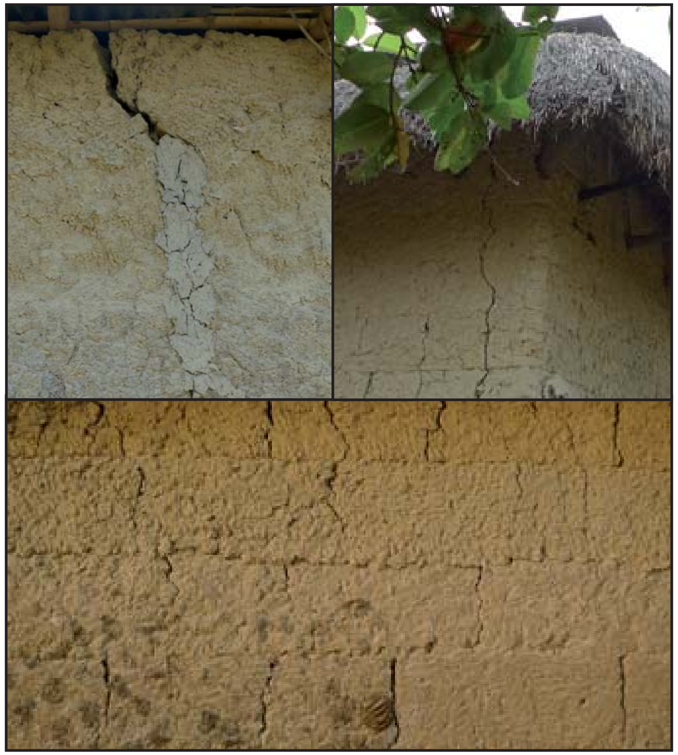


Ashashuni

Ventilation reduces air humidity and thus perceived temperature (wind chill factor).

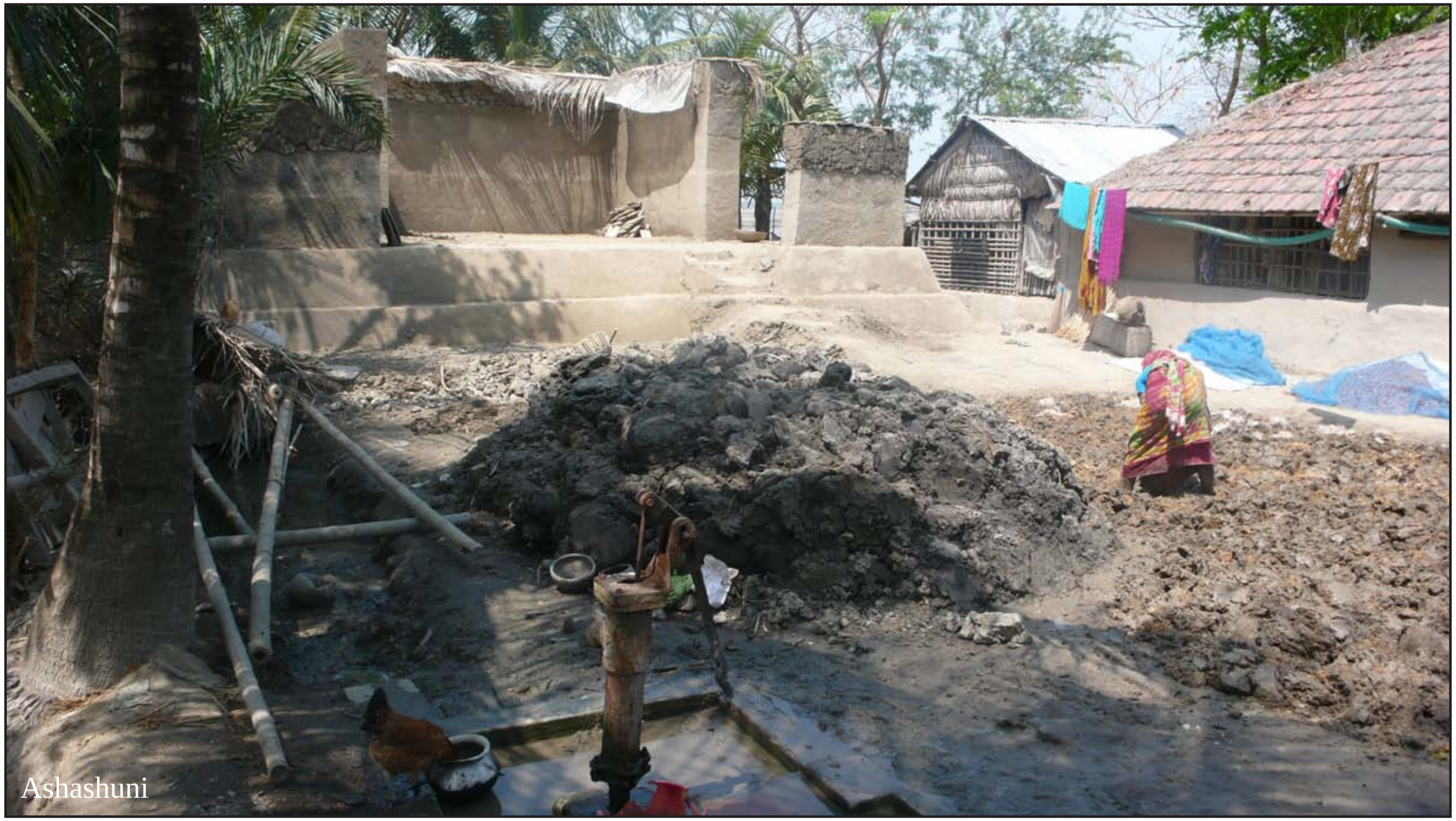
- BAD COB CONSTRUCTION -



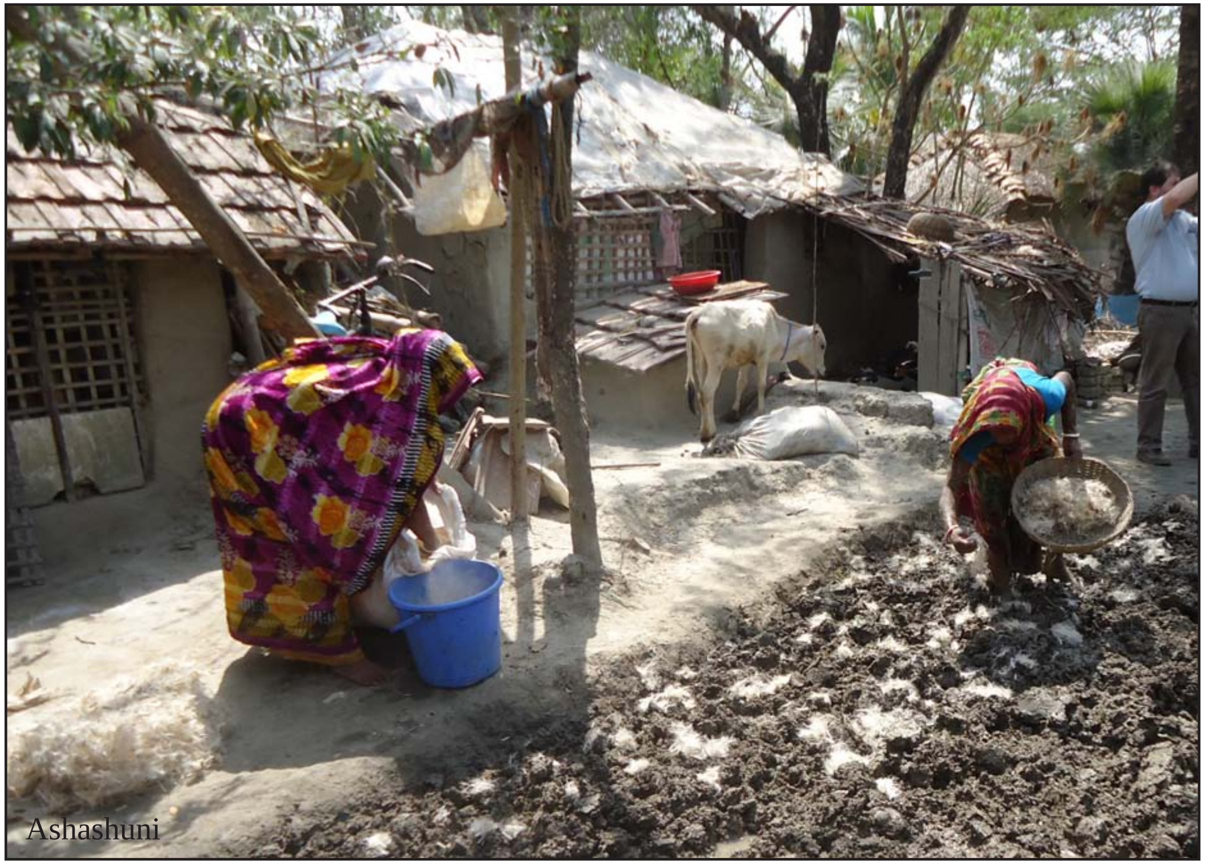


- Cob construction / good practices -

site organisation



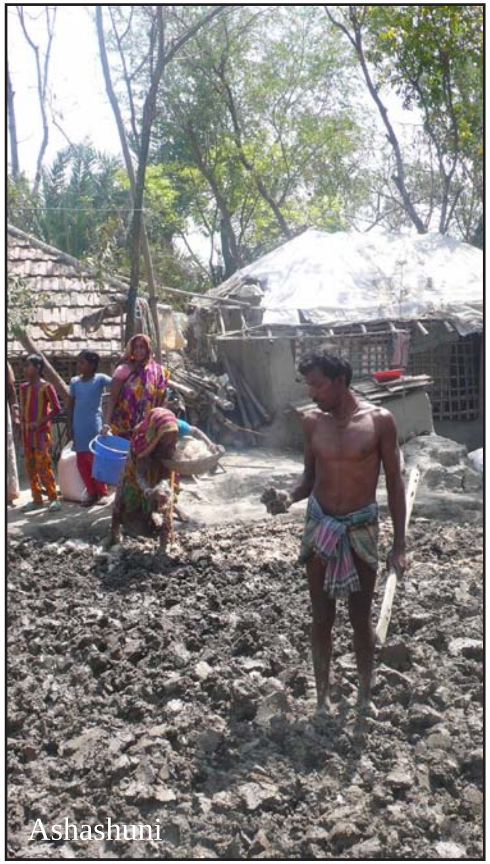
Cob construction / good practices -
mud preparation - adding fiber against shrinckage

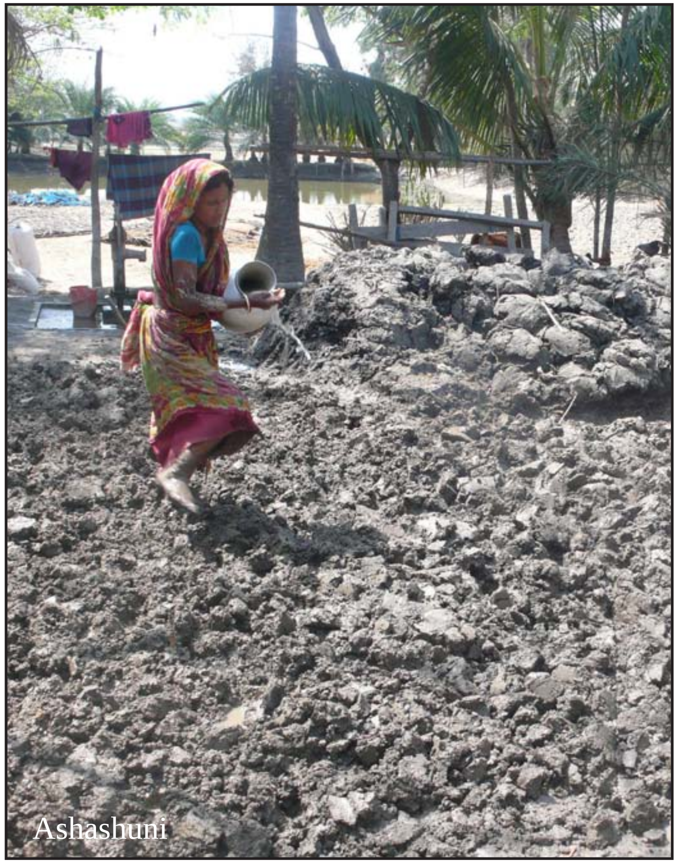


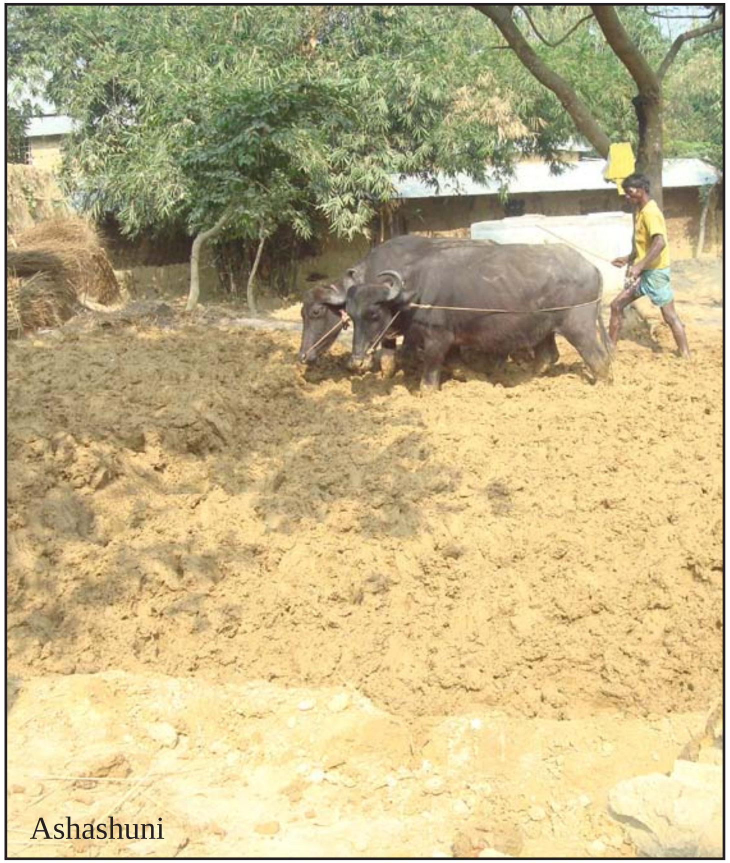
Ashashuni

- Cob construction / good practices -

mud preparation - mixing

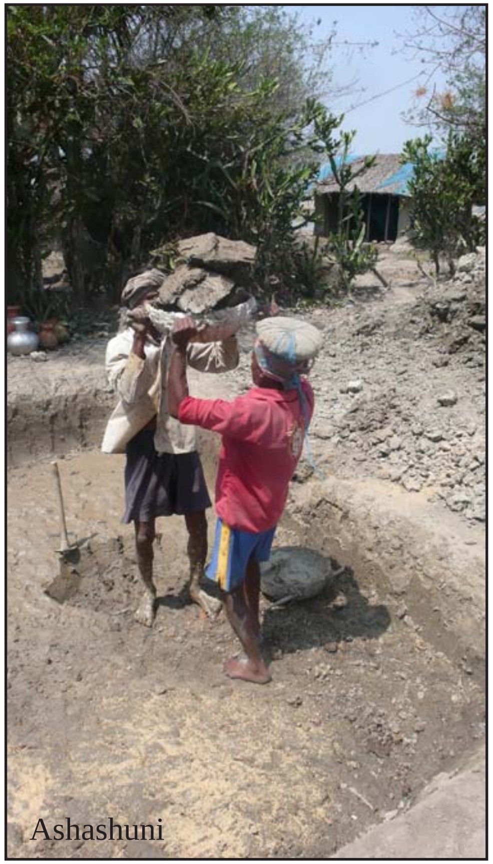

Ashashuni


Ashashuni


Ashashuni

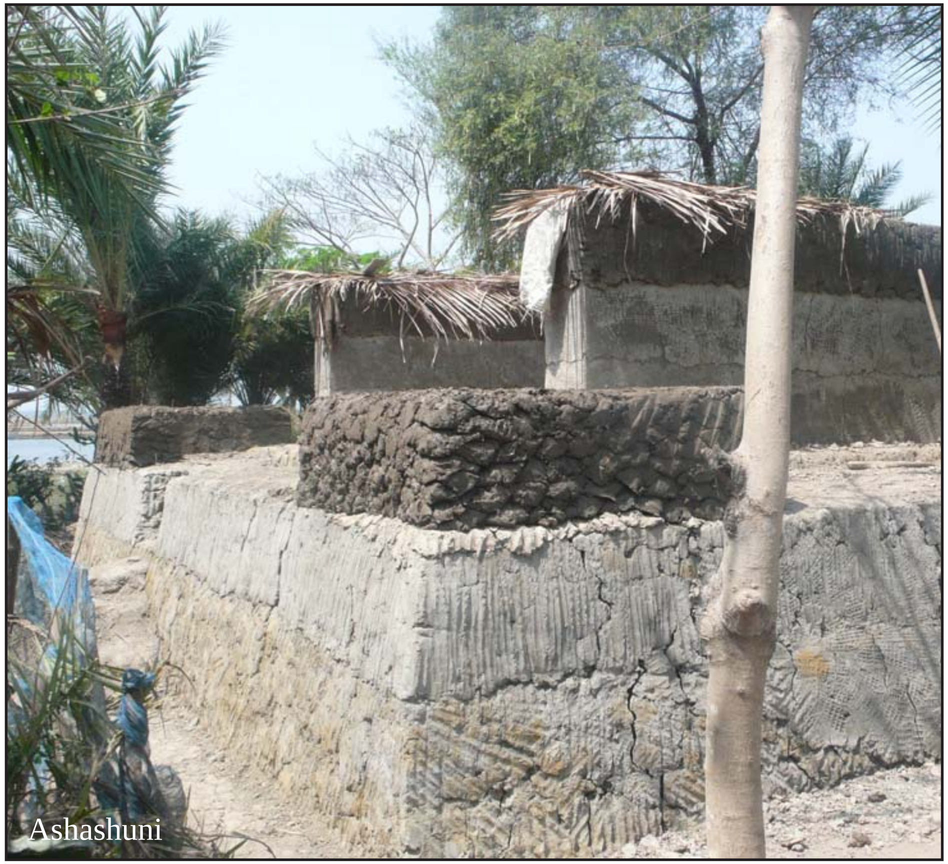
Cob construction / good practices -

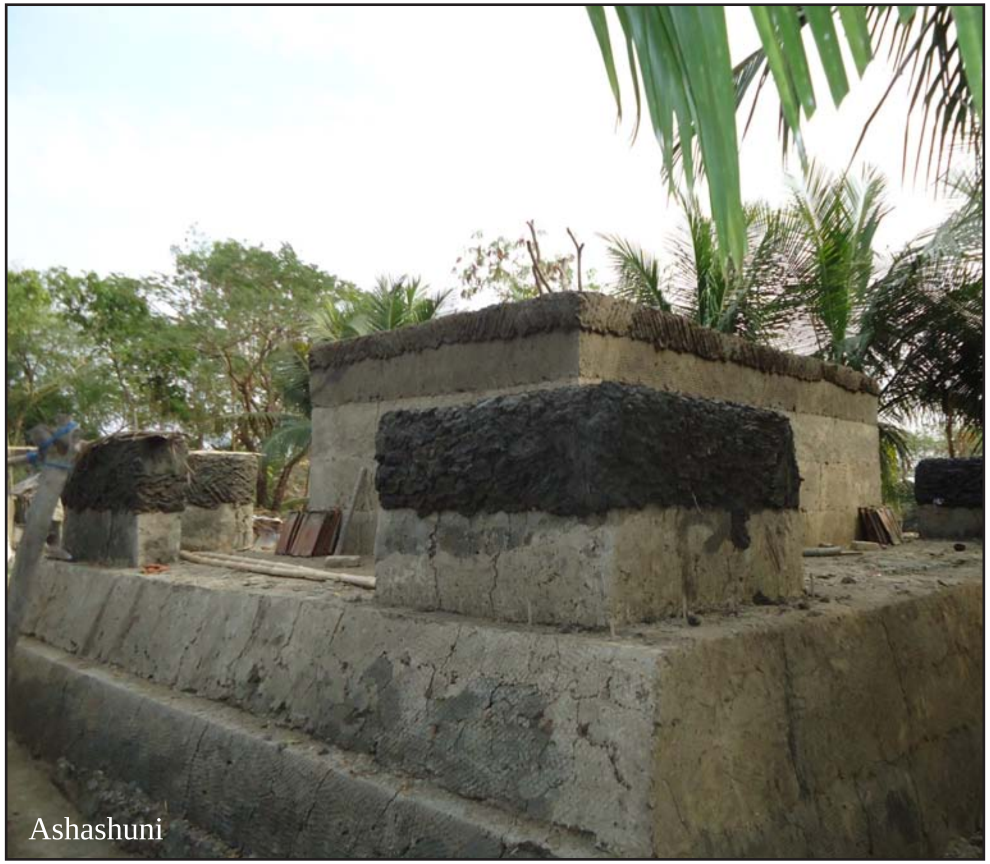
mud transport


Ashashuni

- Cob construction / good practices -

wall construction

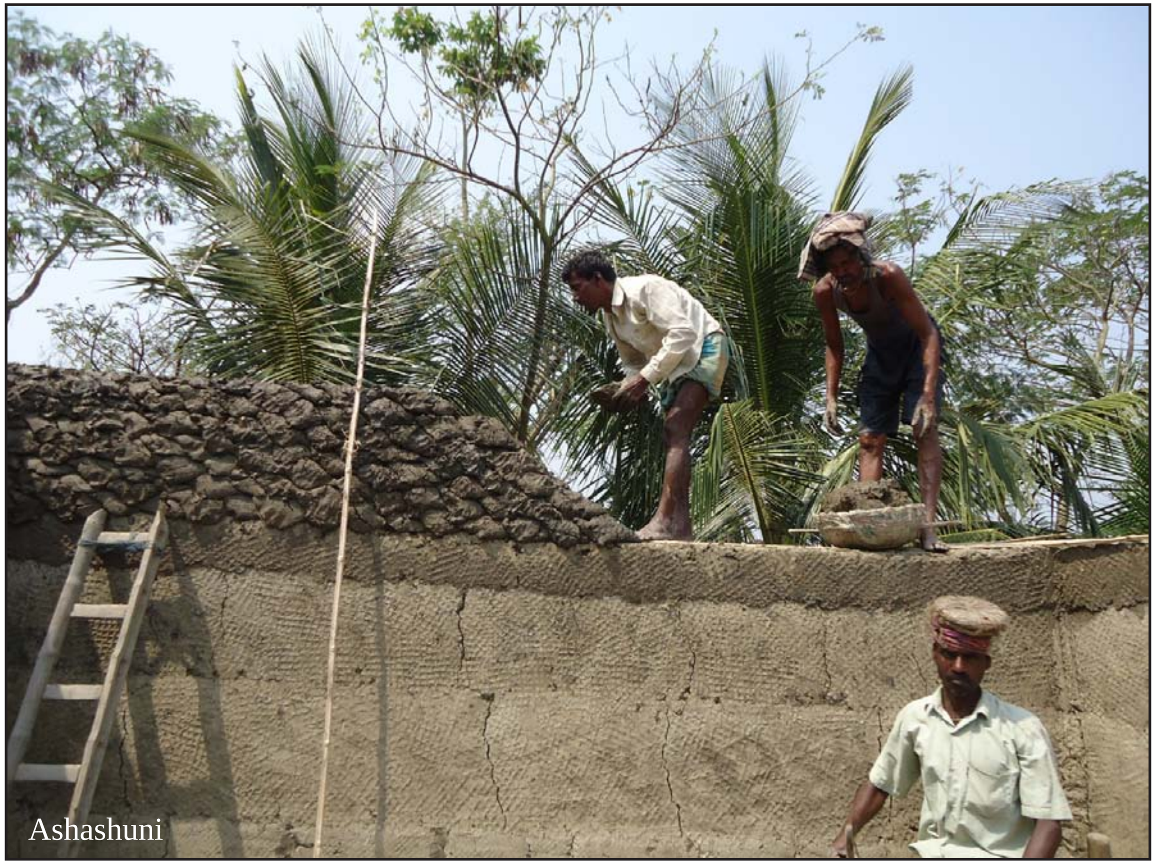




Building in stages ; after drying the former layer, a new one is added (never more than 1 meter at a time).

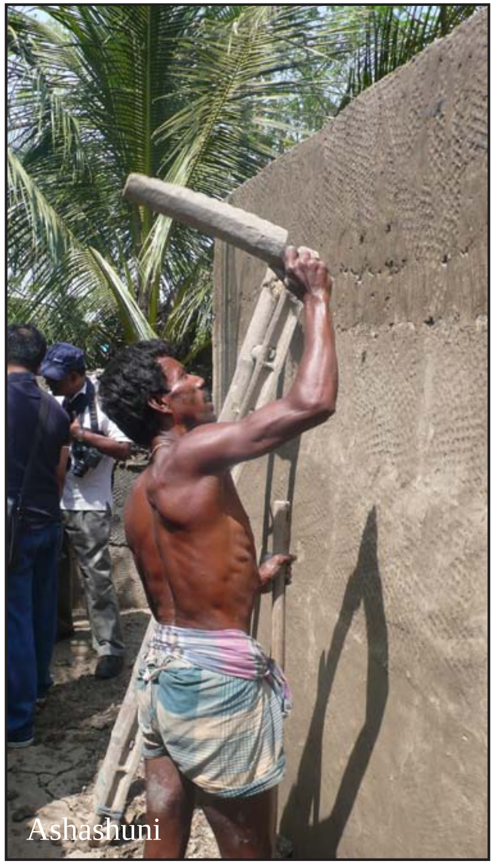
Cob construction / good practices -

wall construction


Ashashuni

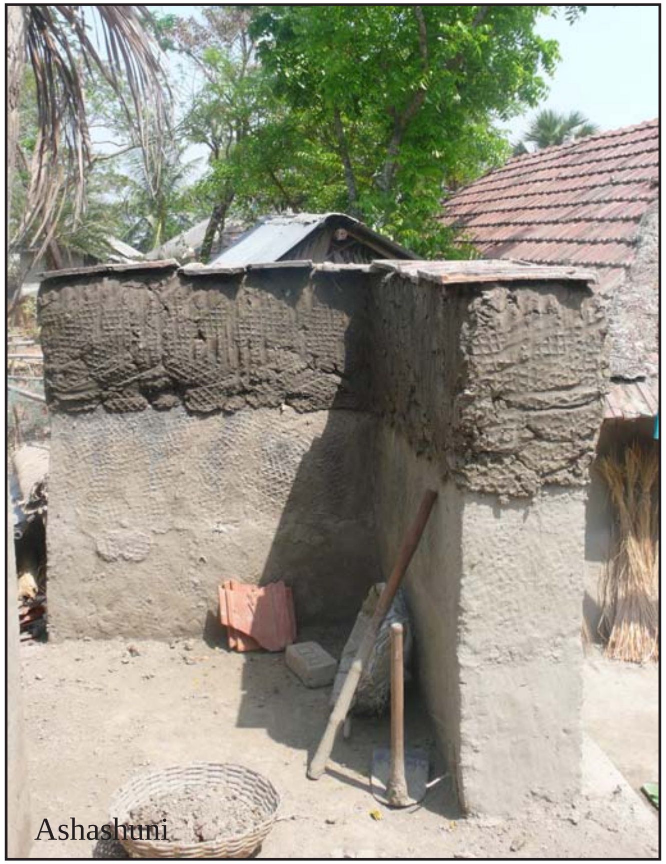
- Cob construction / good practices -

cob ramming



To ram the surface allows to reinforce it against rain water (less porous) and frictions.

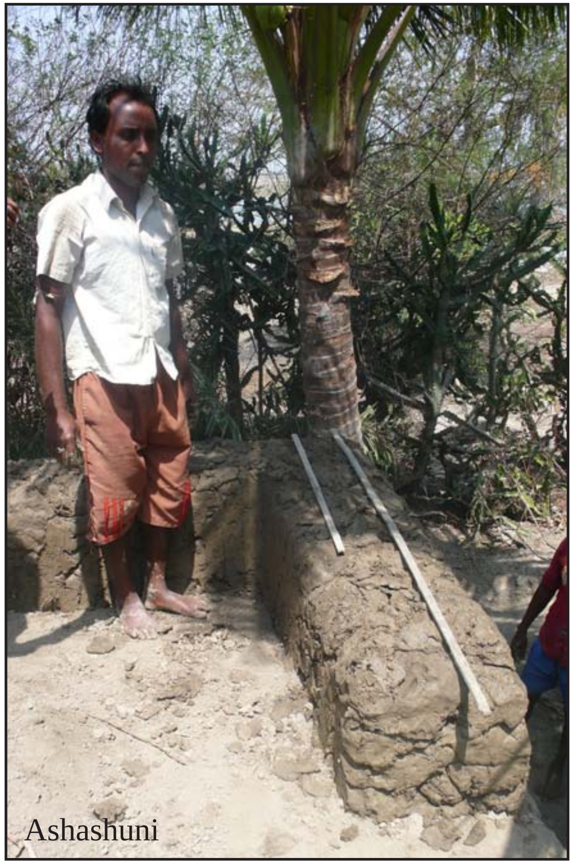
Cob construction / good practices -
protection against fast drying and shrinckage



Covering of the wall.

- Cob construction / good practices -

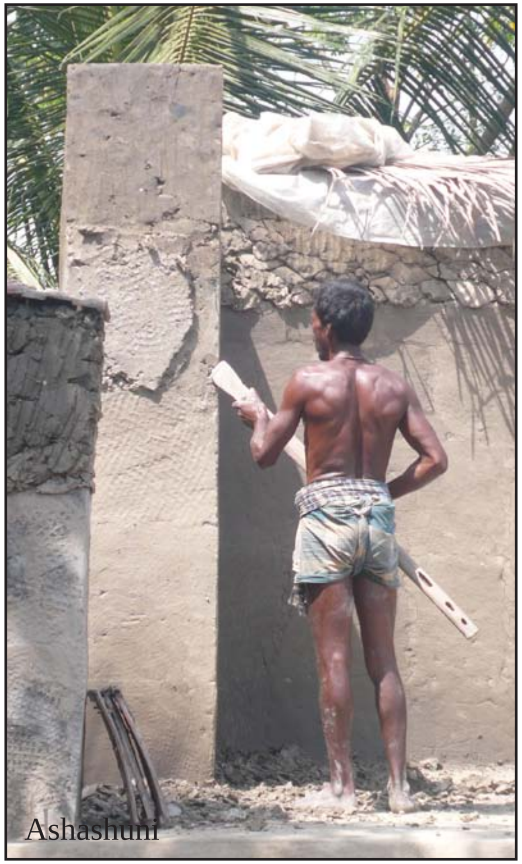
protection against shrinckage



Bamboo inclusion in walls.

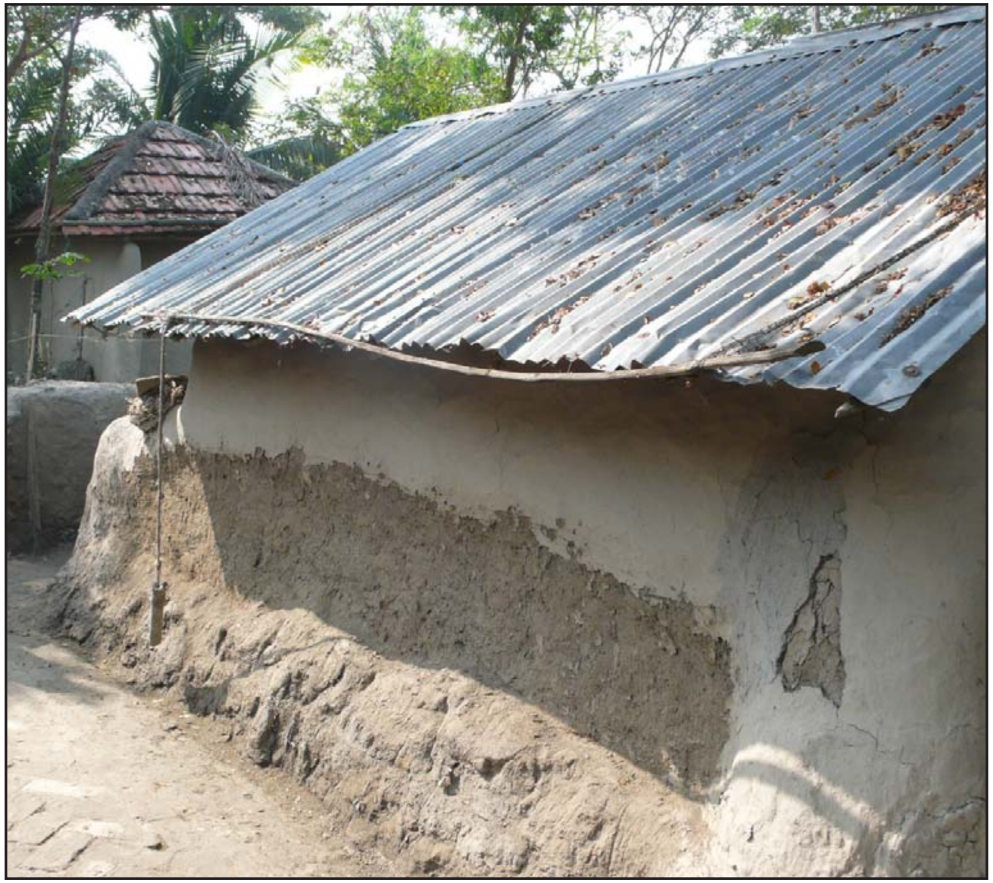
- Cob construction / good practices -

cob cutting



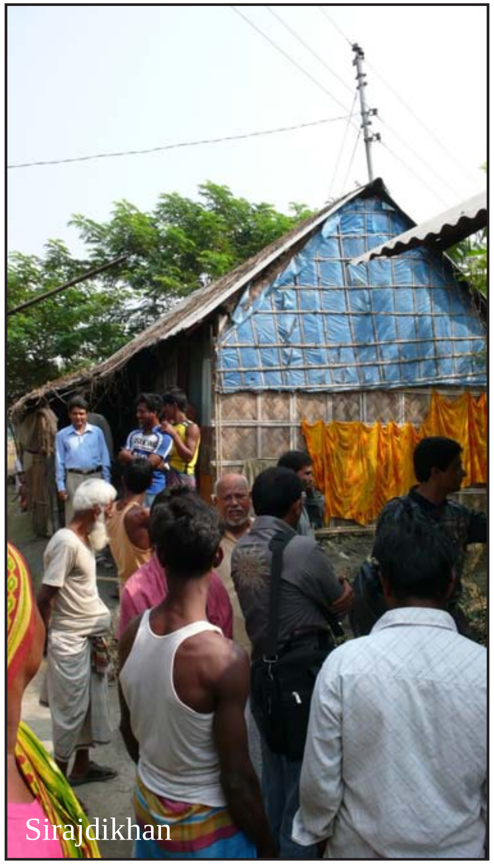
Ashashuni

- WALLS DAMAGED BY RAIN -

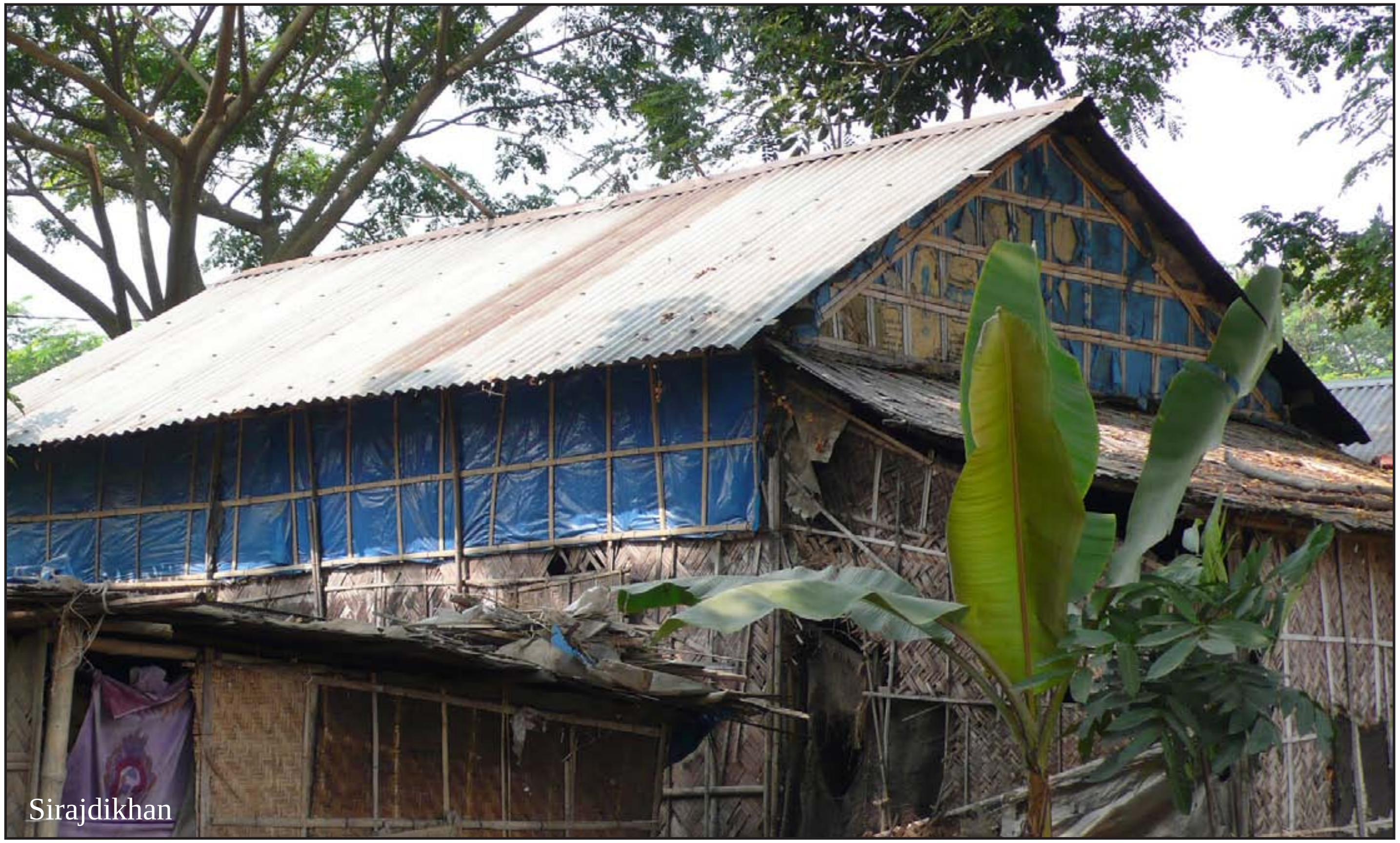


- Wall protection against rain under prevailing winds -

frontage covering by plastic sheet



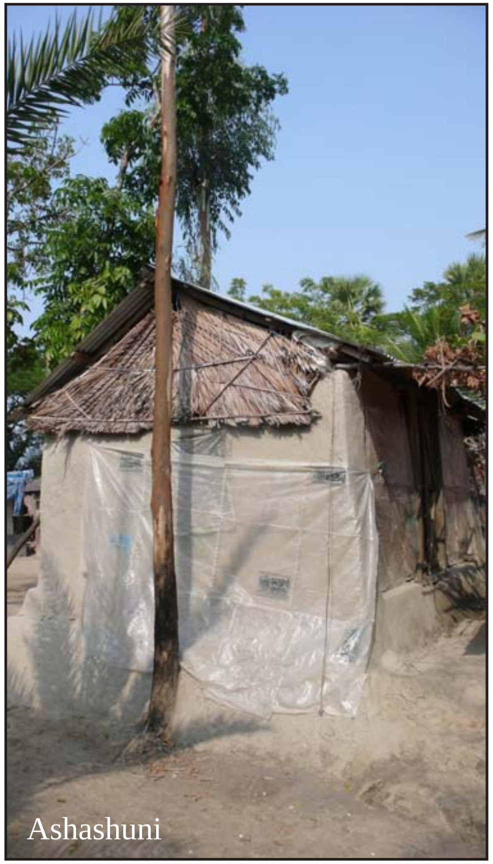
Sirajdikhan

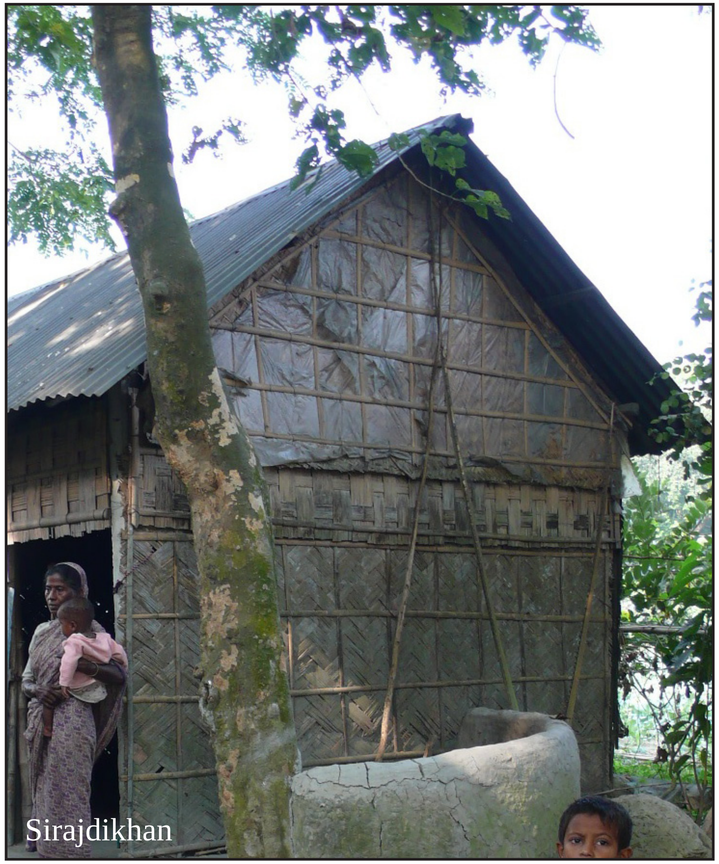


Sirajdikhan

- Wall protection against rain under prevailing winds -

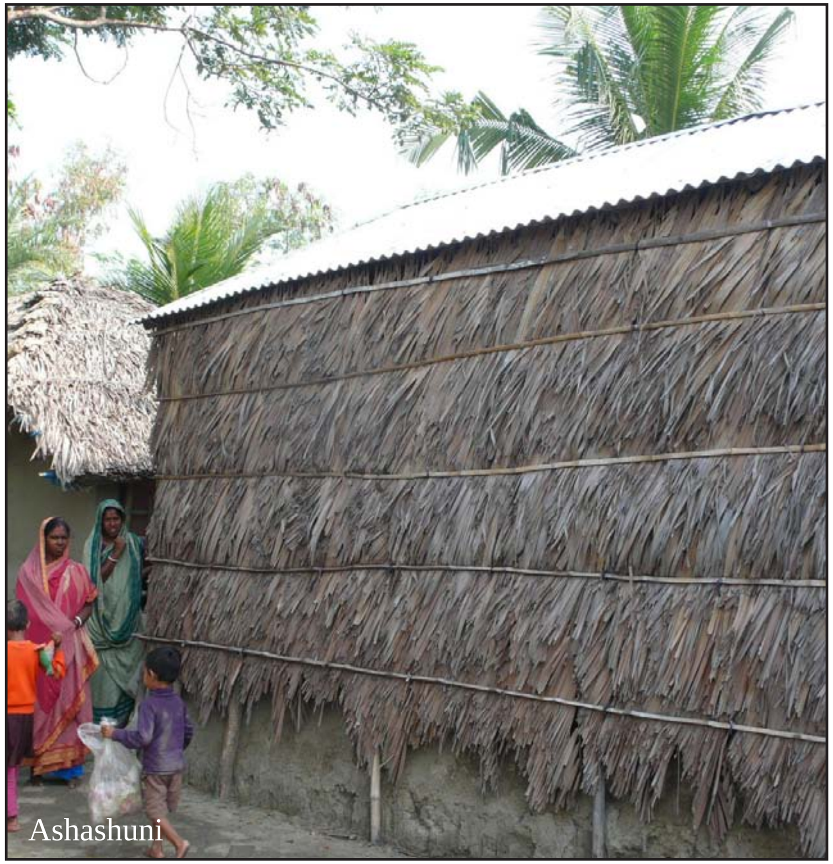
frontage covering by plastic sheet

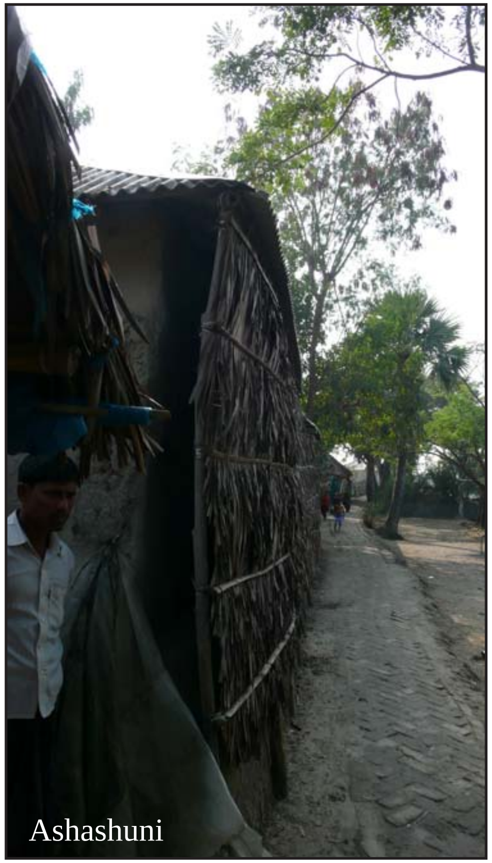


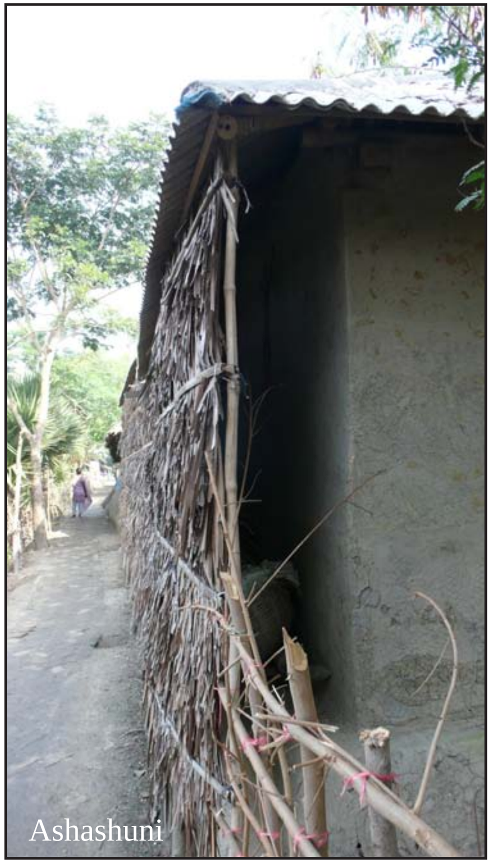


- Wall protection against rain under prevailing winds -

double green wall

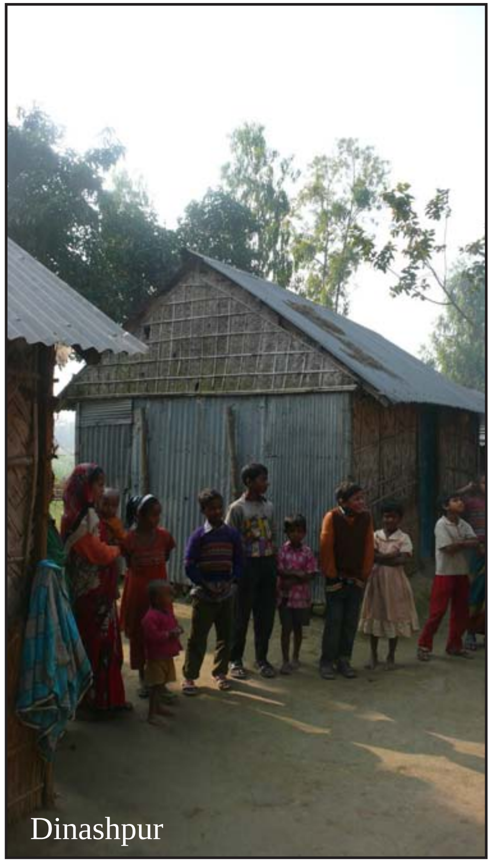

Ashashuni


Ashashuni

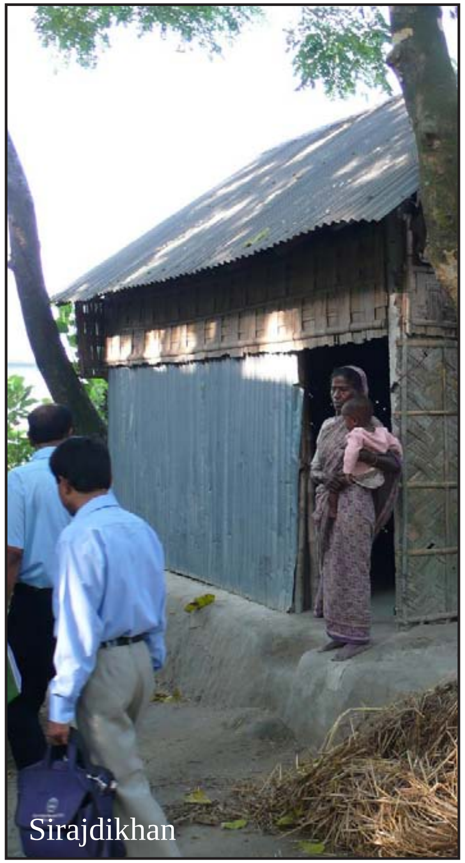

Ashashuni

- Wall protection against rain under prevailing winds -

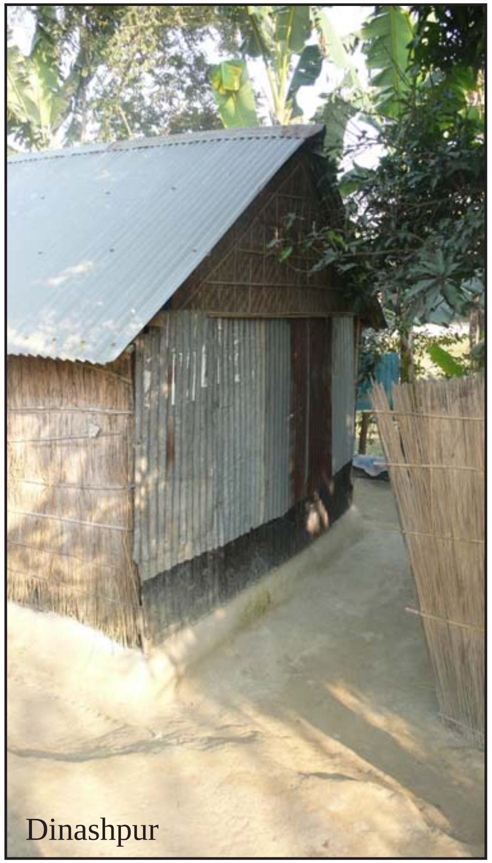
iron sheet frontage



Dinashpur



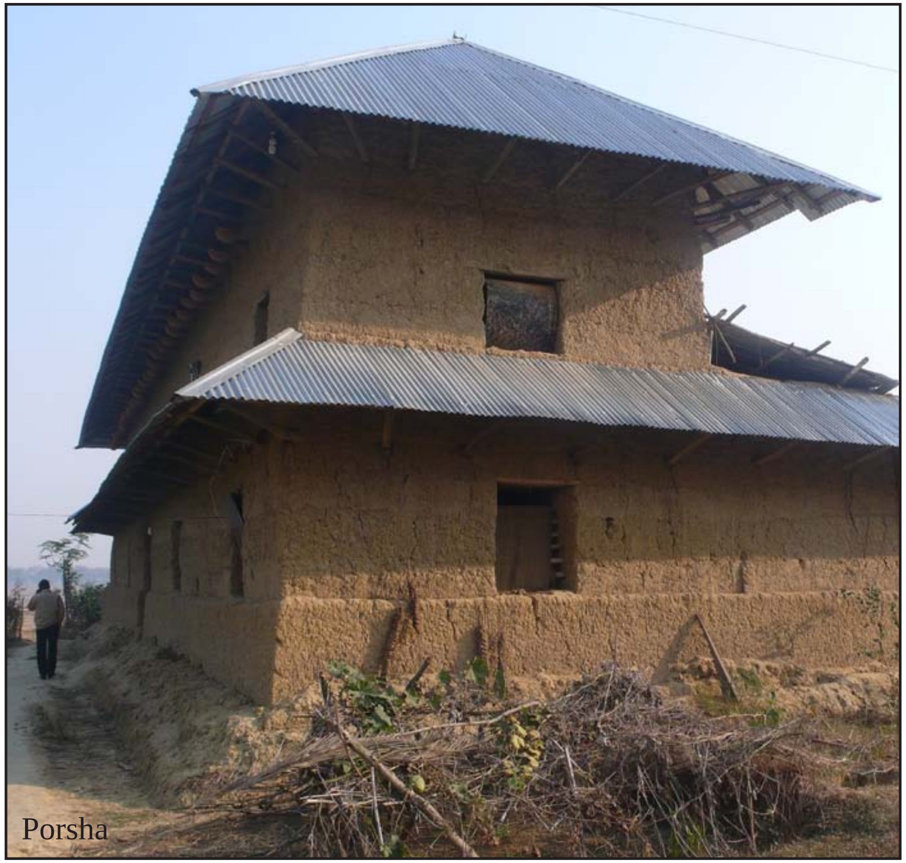
Sirajdikhan



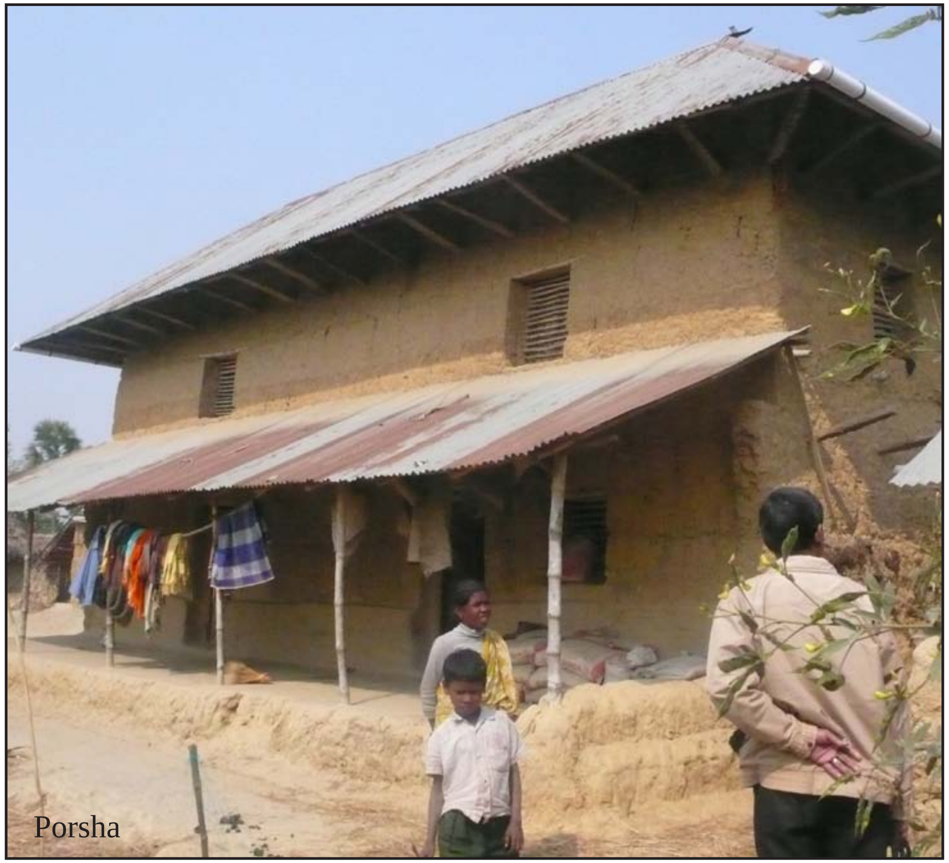
Dinashpur

Iron sheet is much more waterproof and resistant than other locally available materials which need maintenance on a regular base. On the other hand it is more expensive and it makes heating up the temperature inside the building.

- Wall protection against rain under prevailing winds - overhanging roof



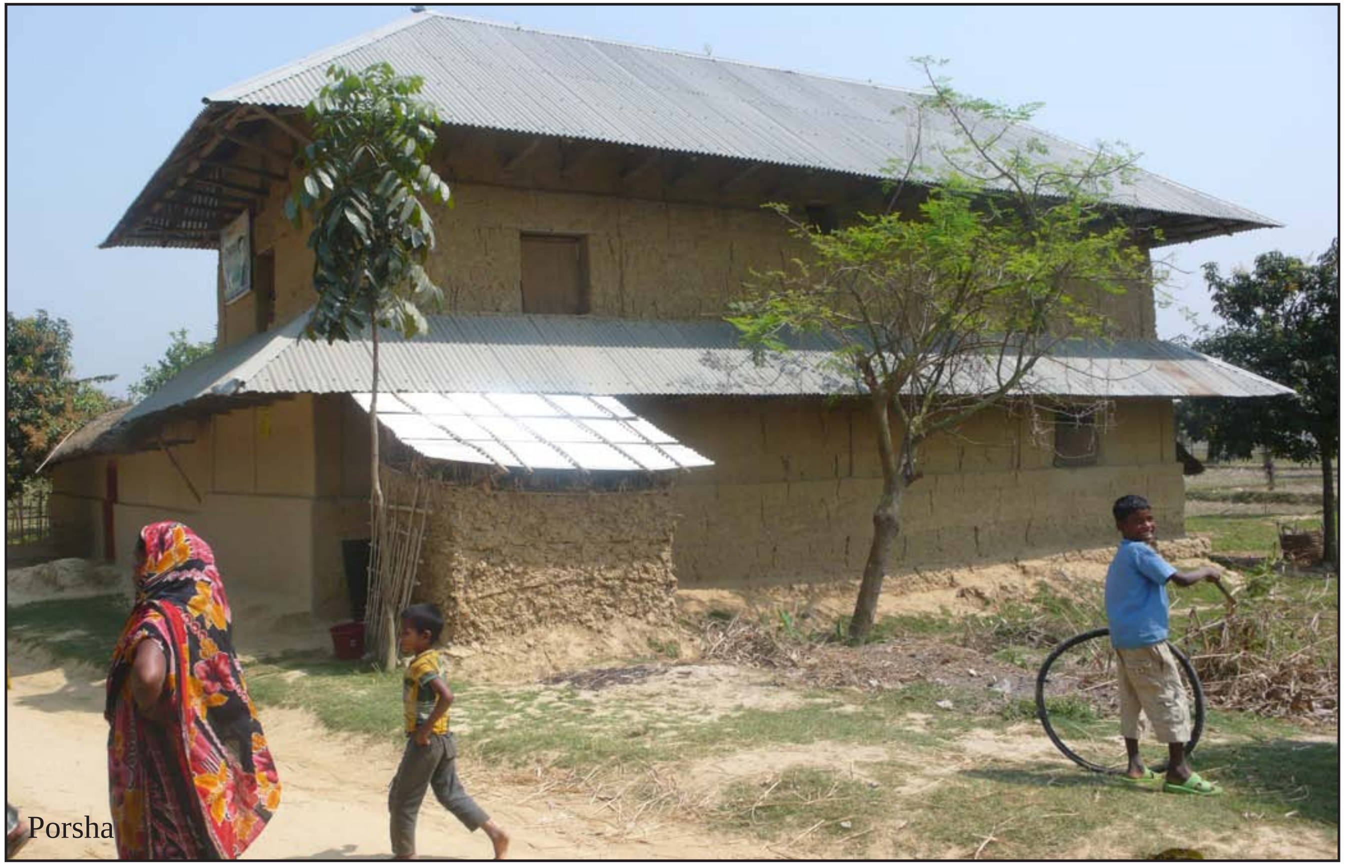
Porsha



Porsha

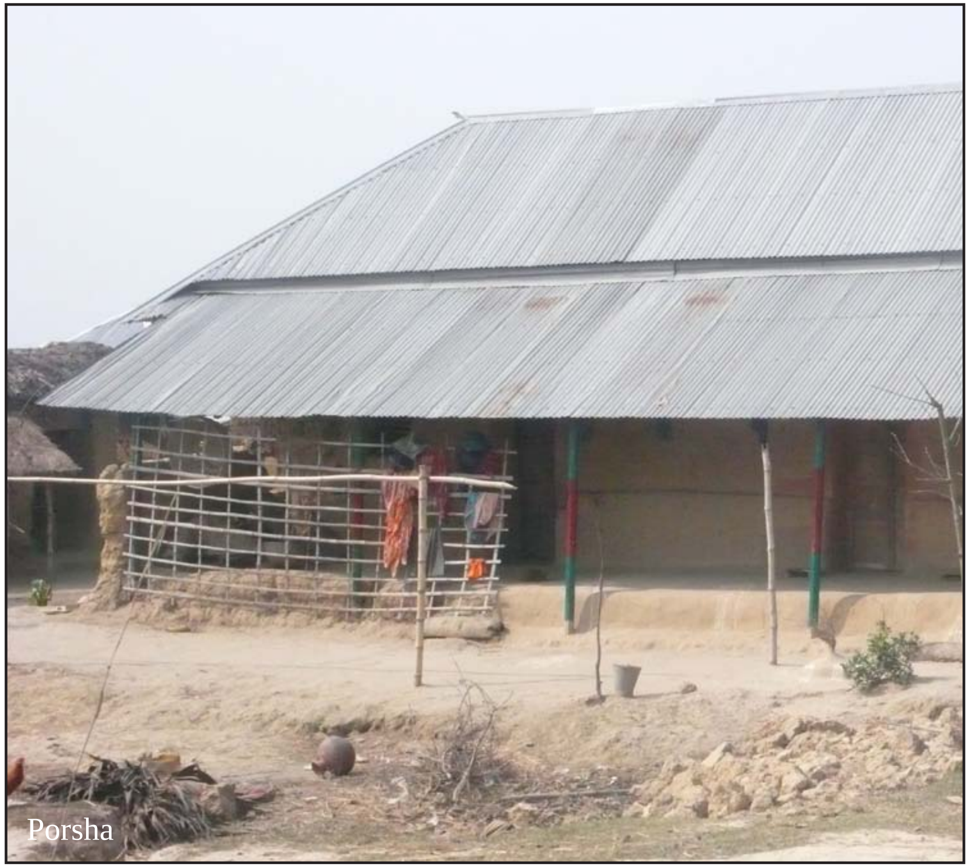
The frontage receives less rain water.

- Wall protection against rain under prevailing winds - overhanging roof

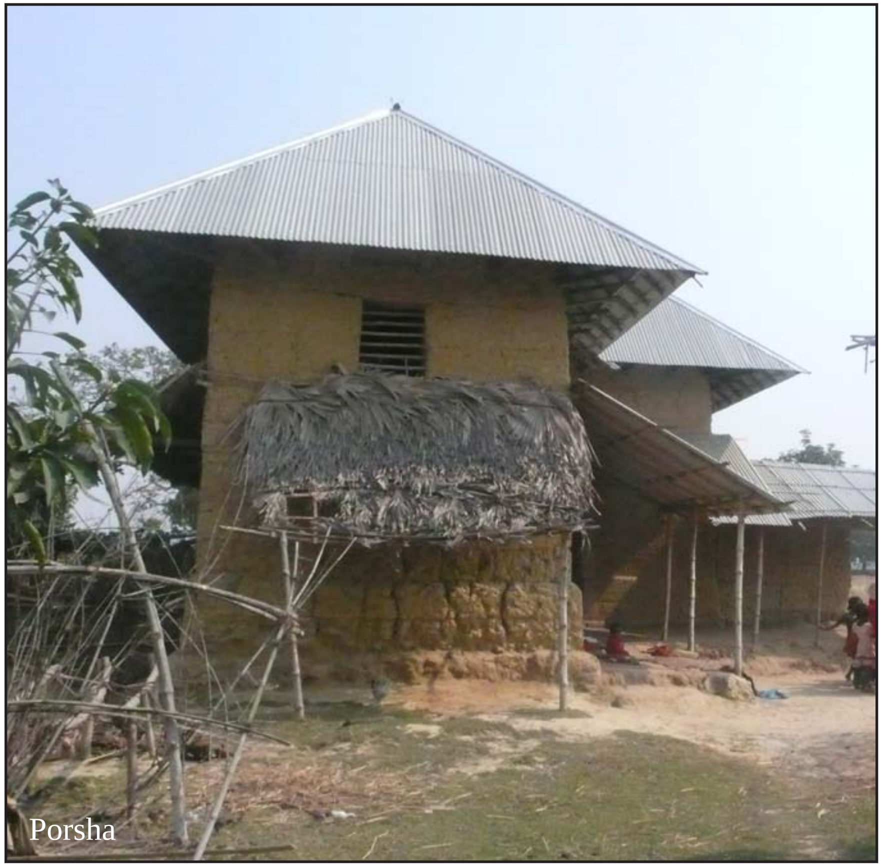


The frontage receives less rain water.

- Wall protection against rain under prevailing winds - overhanging roof



Porsha

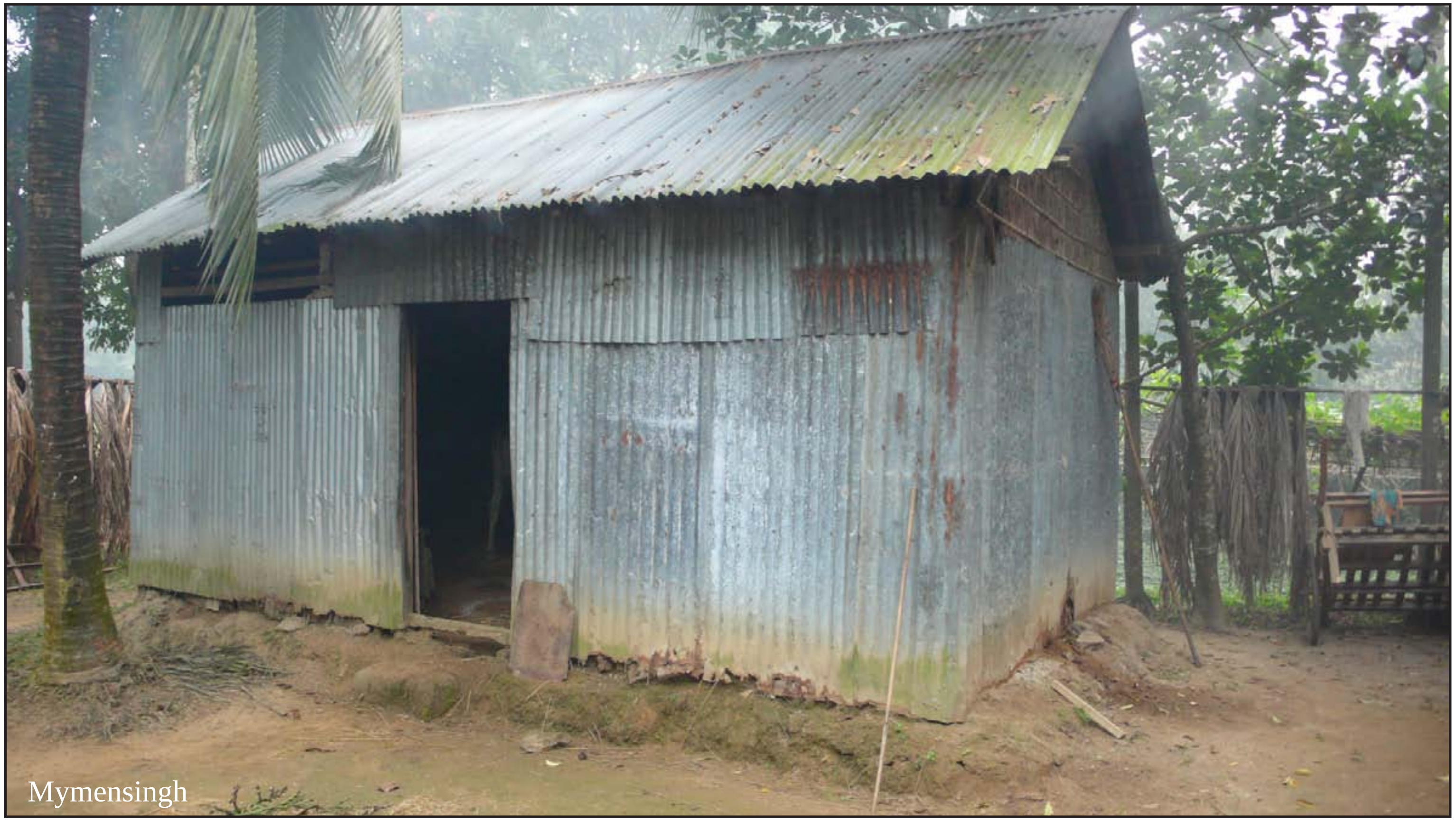


Porsha

The frontage receives less rain water.

- GROUND HUMIDITY -

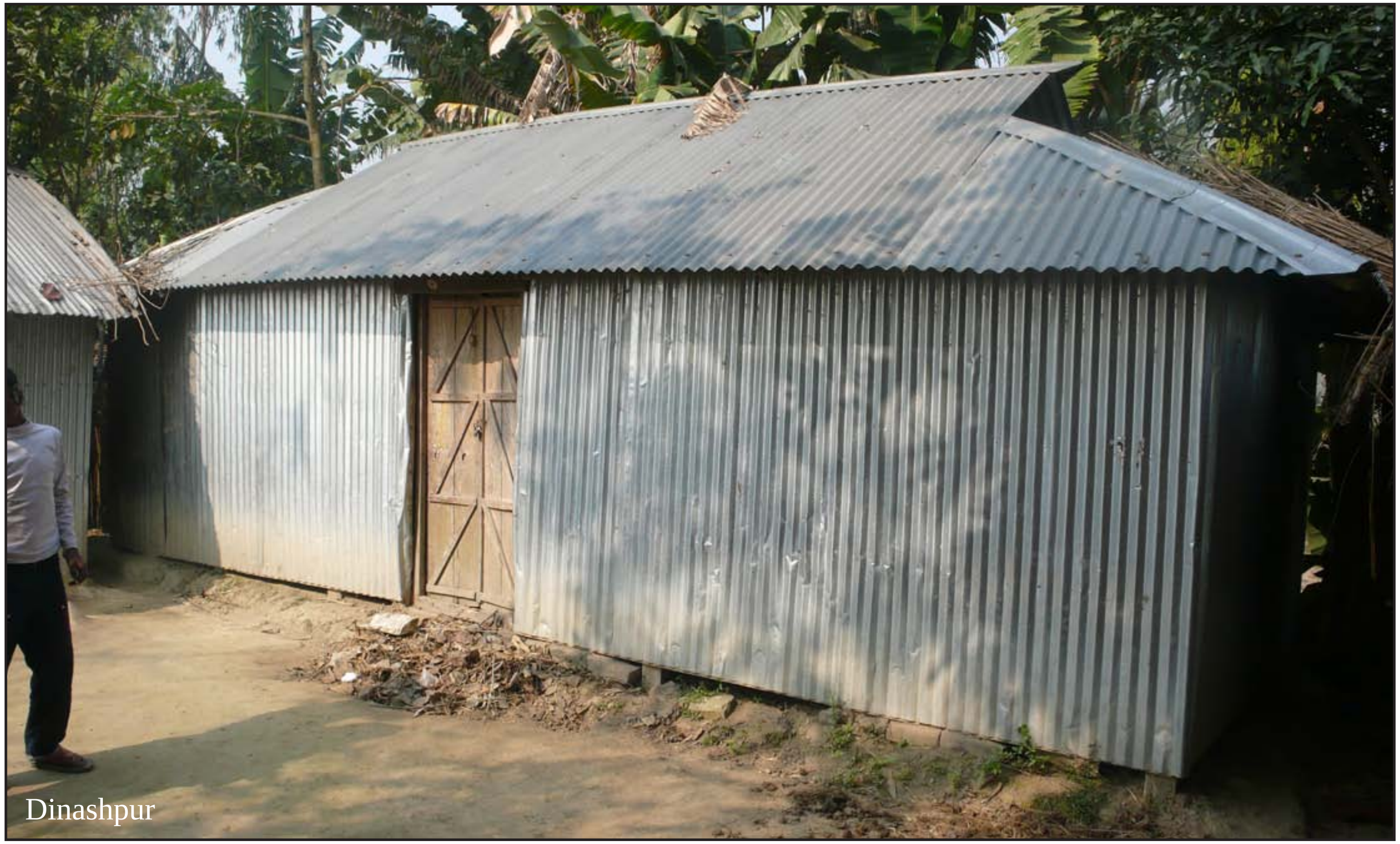
Wall base damaged



Soil moisture rises up by capillarity and affects the wall base.

- Wall base protection -

raising walls disconnected from the ground

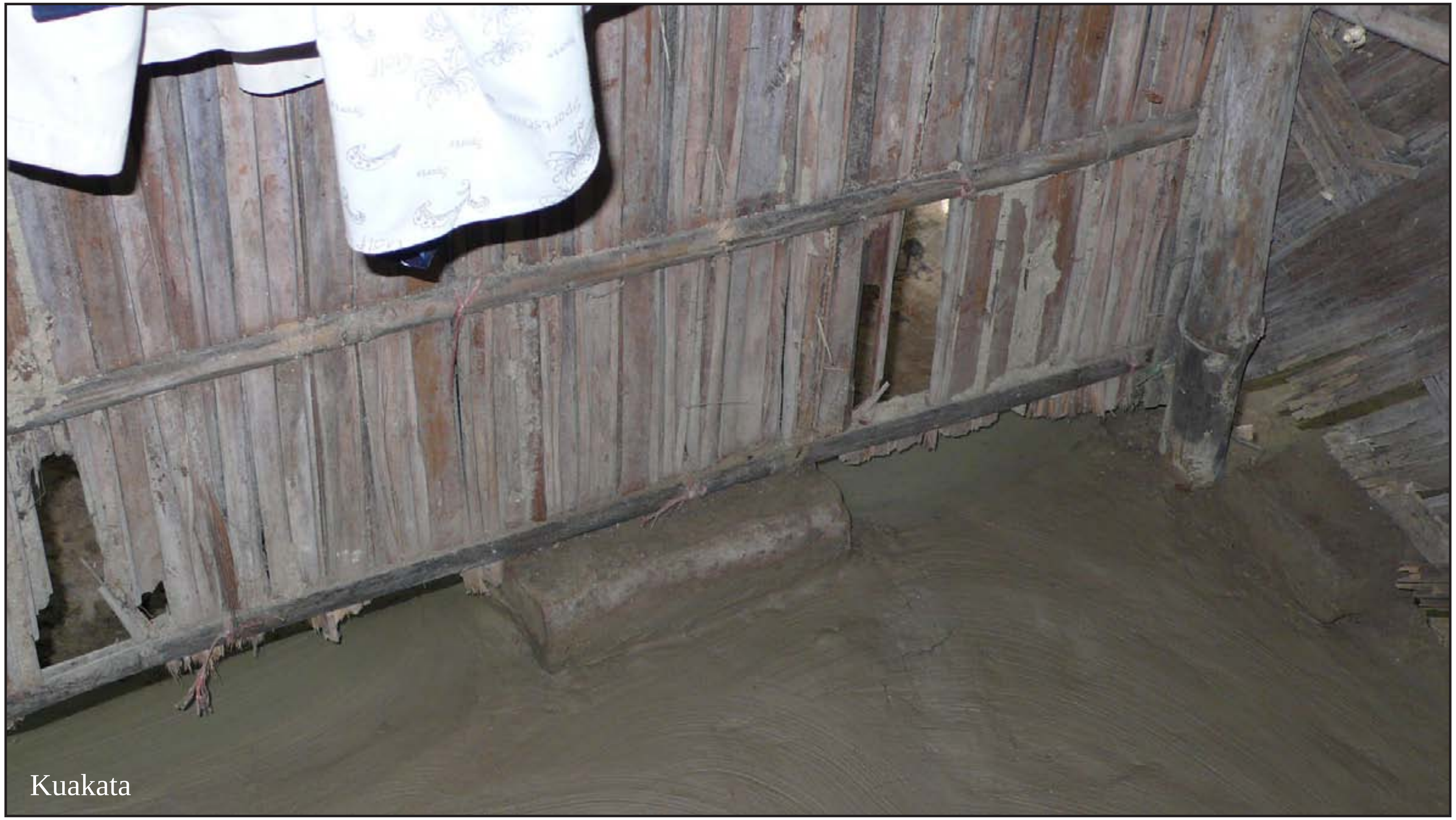

Dinashpur

Dinashpur

Those walls are disconnected from the ground and thus are protected from capillarity rise.

- Wall base protection -

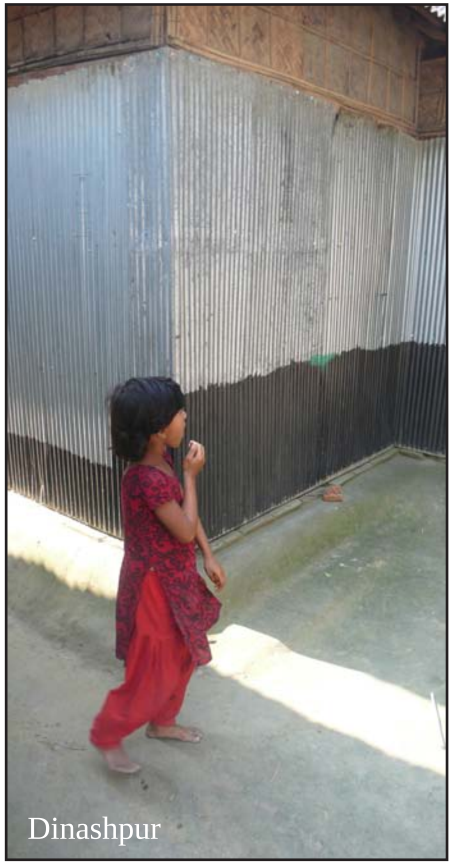
raising walls disconnected from the ground



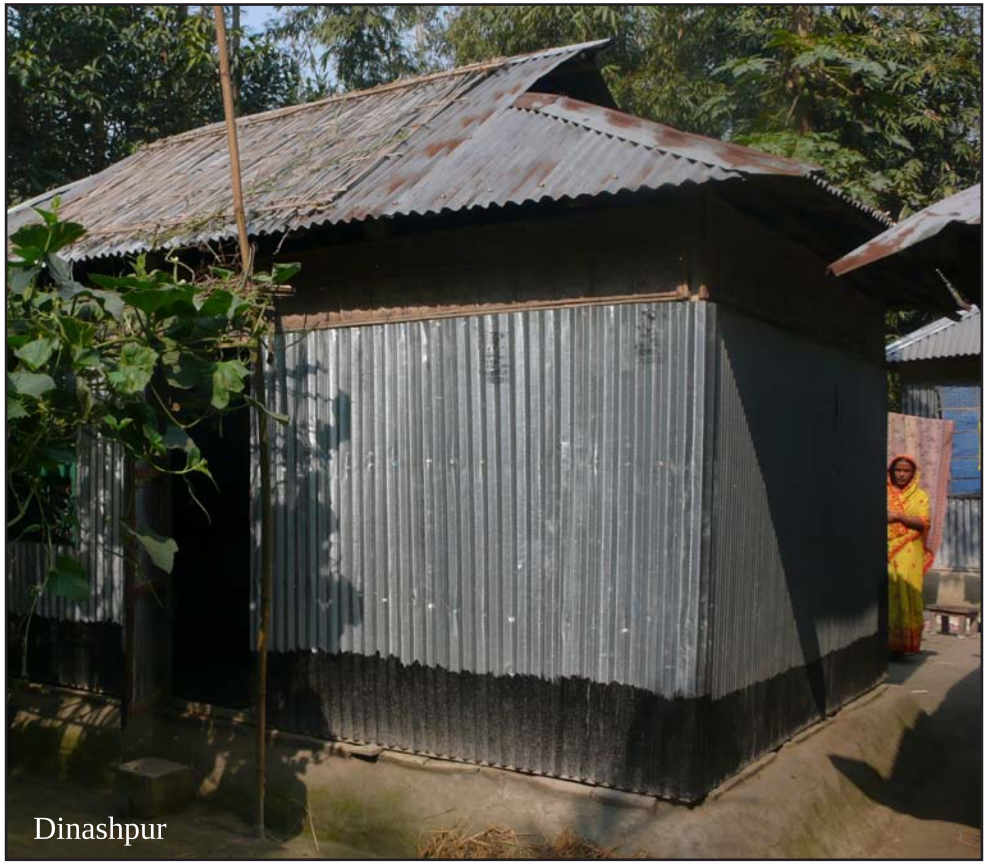
Those walls are disconnected from the ground and thus are protected from capillarity rise.

- Wall base protection -

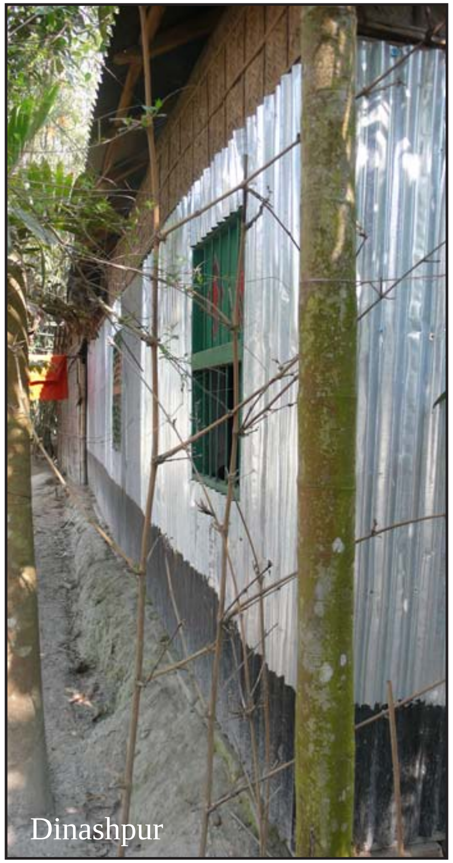
zinc wall base treatment



Dinashpur



Dinashpur

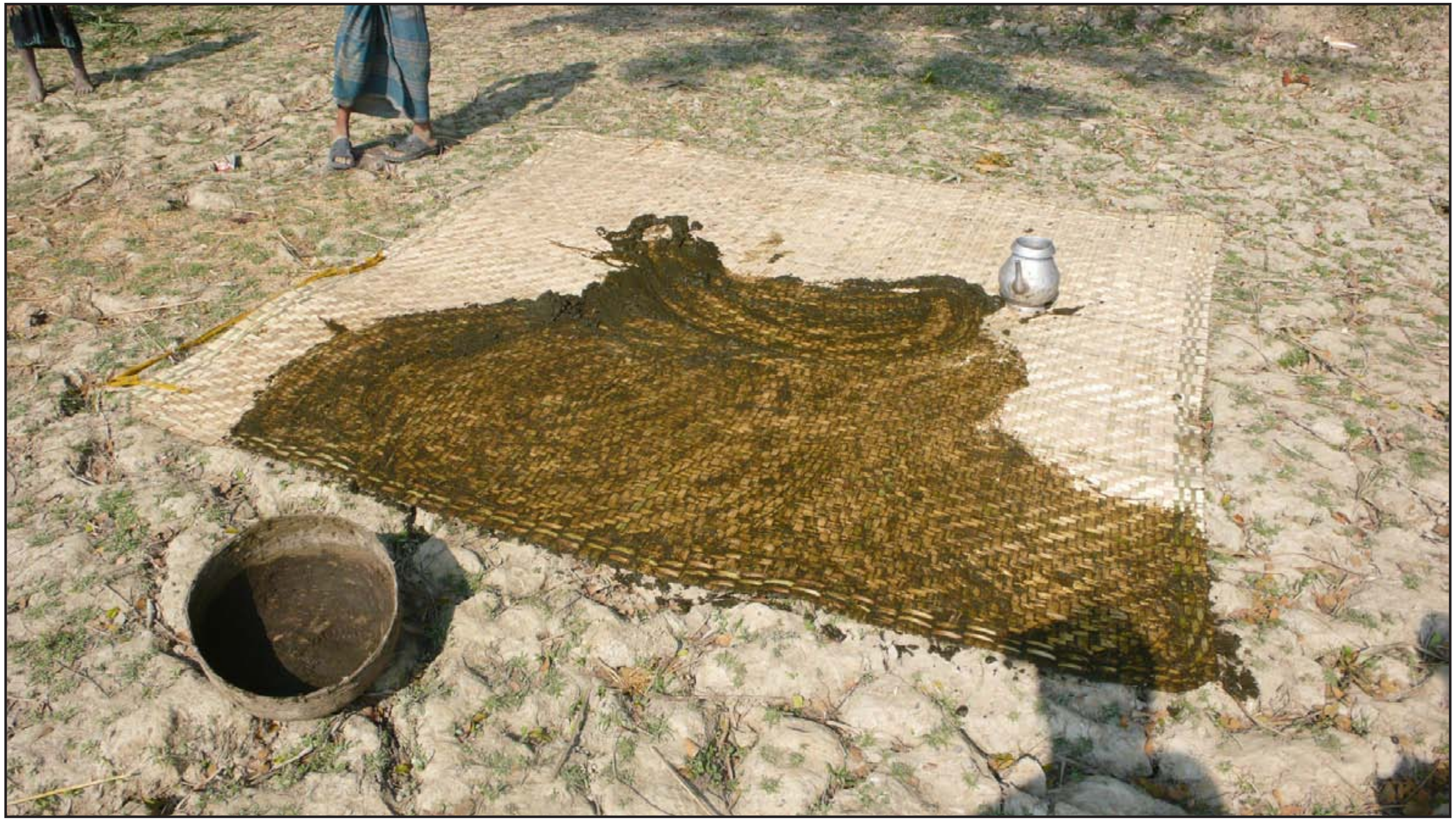


Dinashpur

This treatment partially protects the iron sheets. To keep it efficient, it must be repeated from time to time.

- Wall base protection -

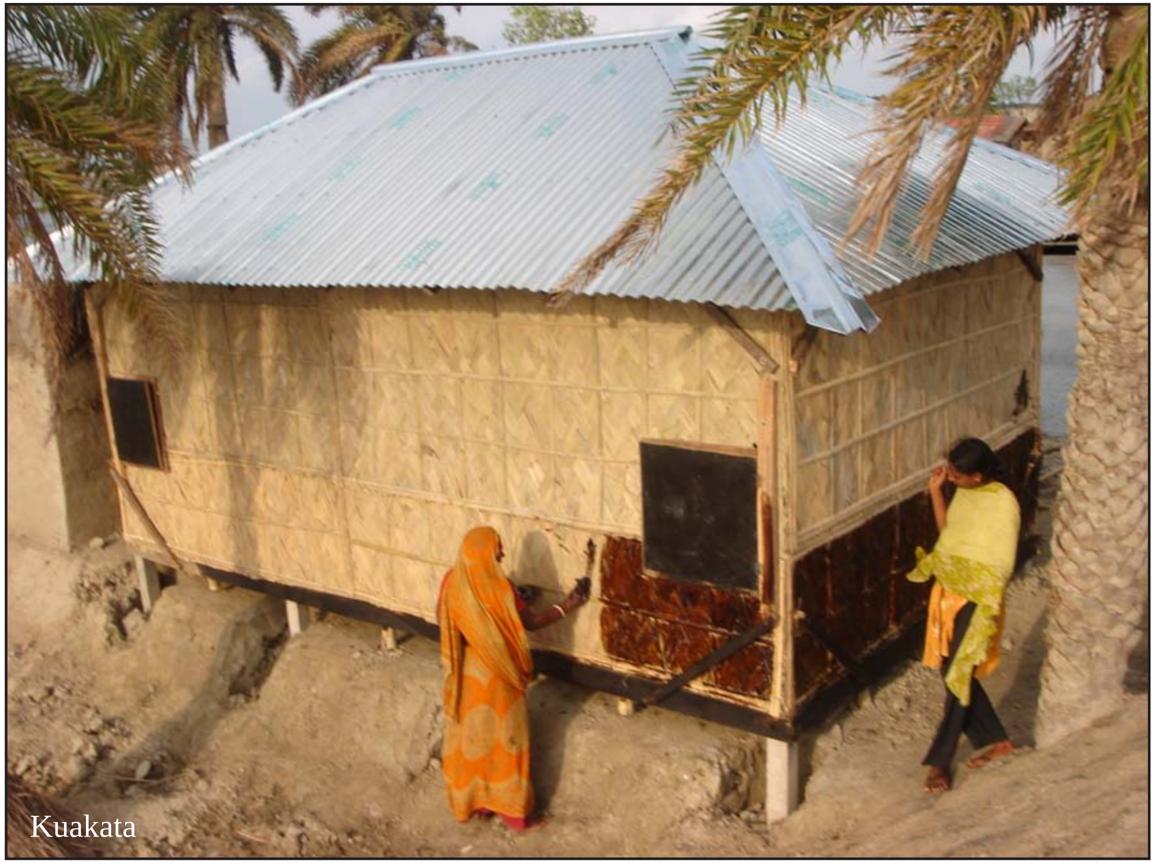
bamboo mat treatment

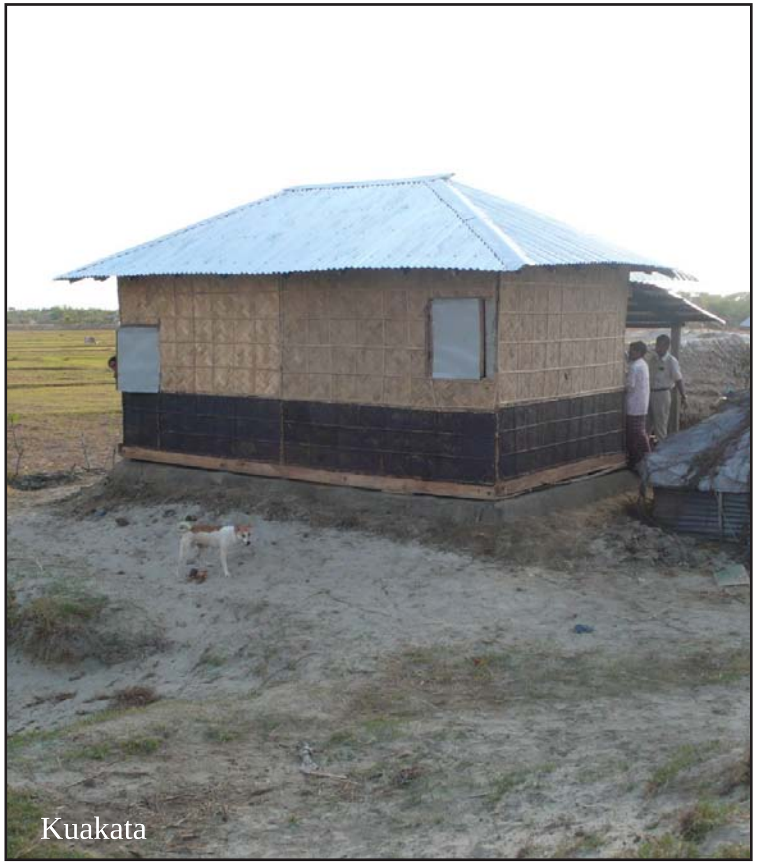


This treatment partially protects these bambou mats. It is regularly applied.

- Wall base protection -

bamboo mat treatment

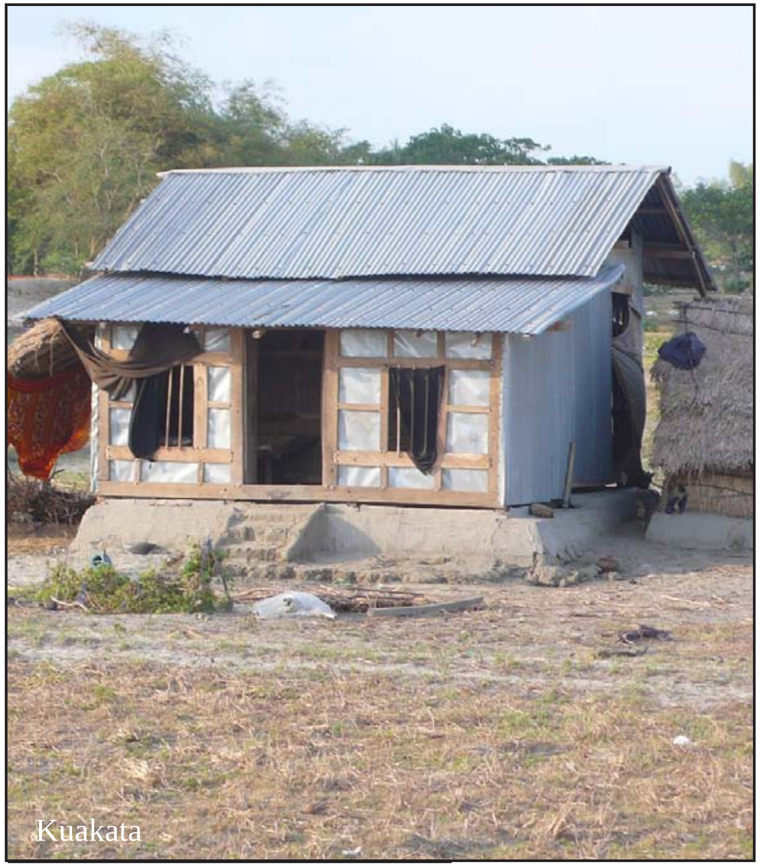




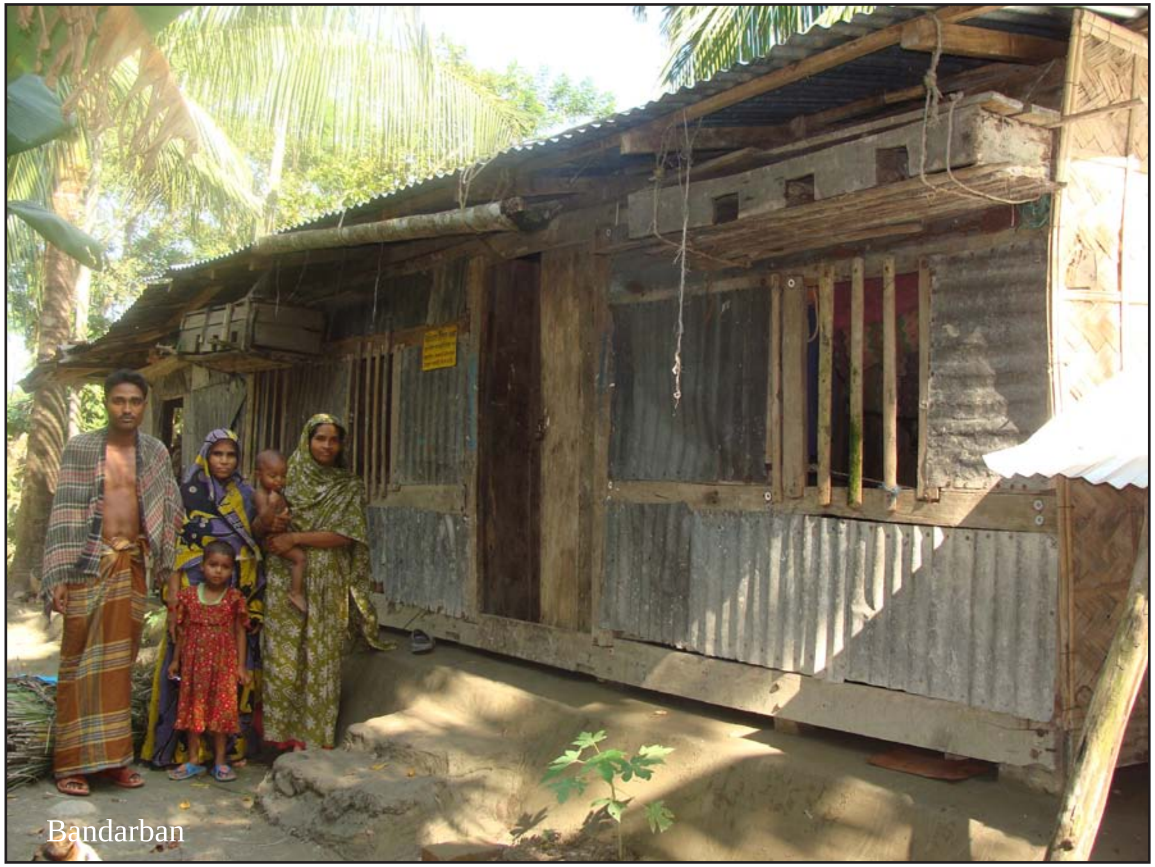
This treatment partially protects the bambou mats. It is regularly applied.

- Wall base protection -

wall panels in walling structure



Kuakata

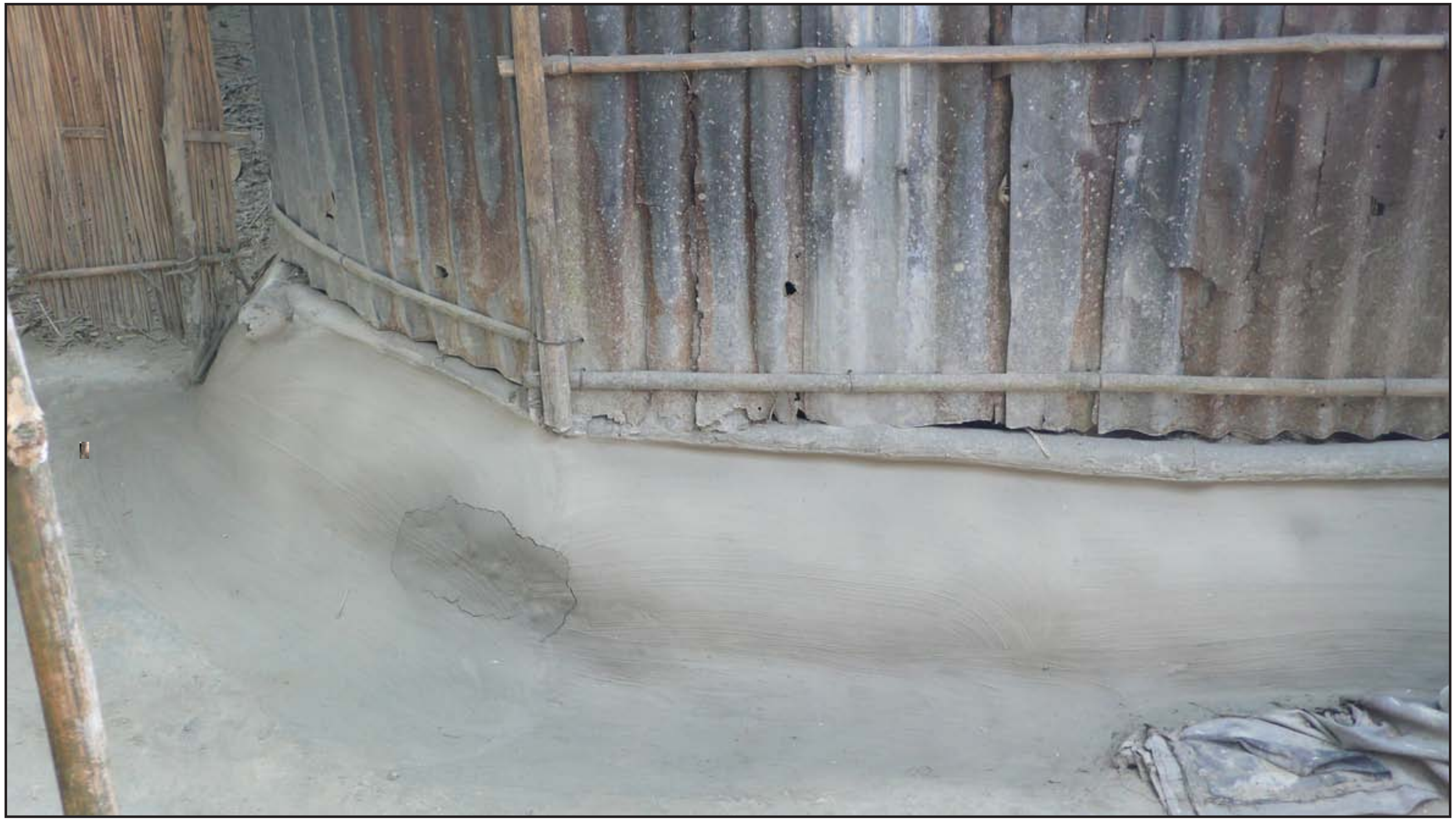


Bandarban

It allows to replace only the damaged elements of the wall, instead of rebuild the whole frontage.

- Wall base protection -

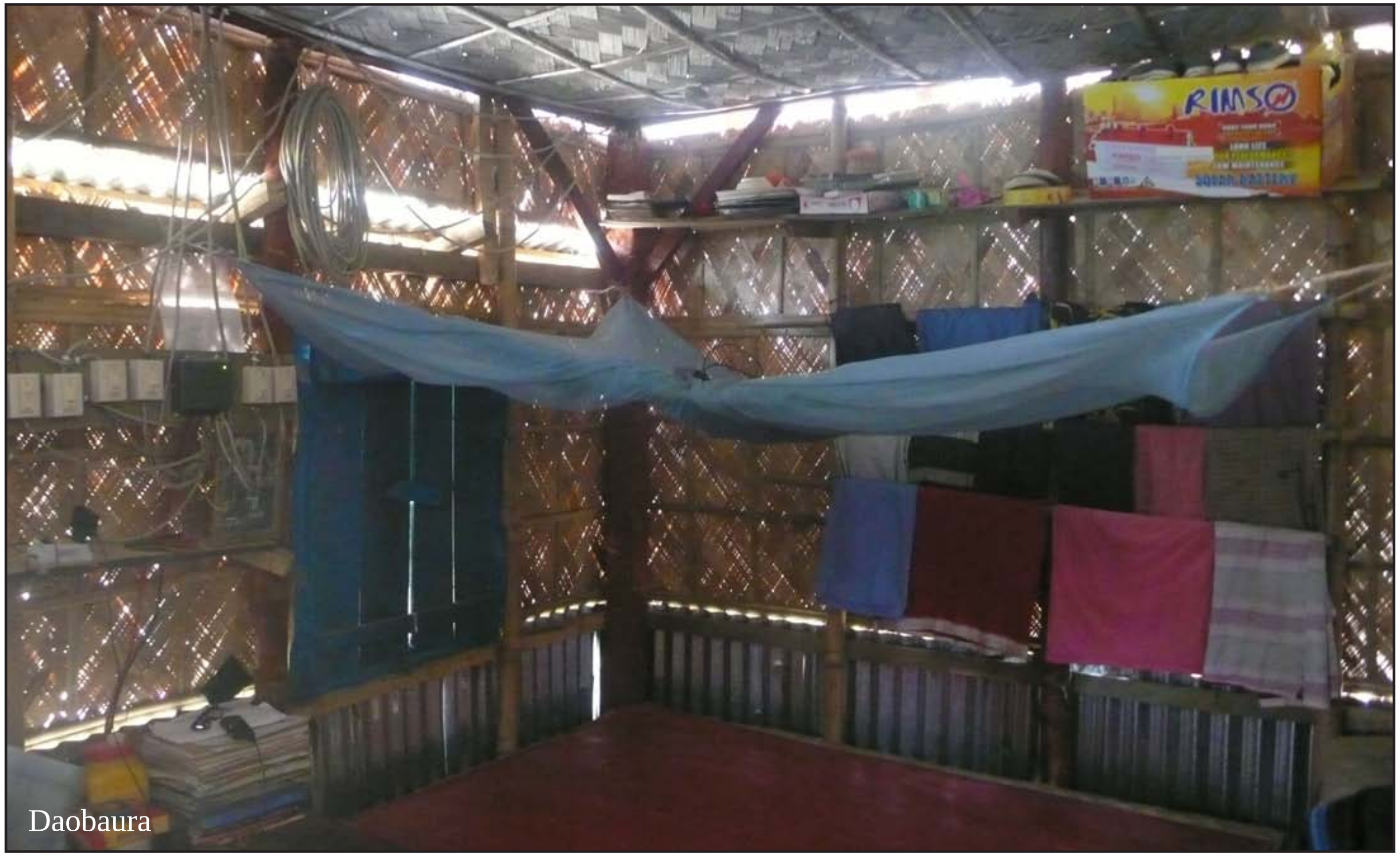
iron sheets laid on wood

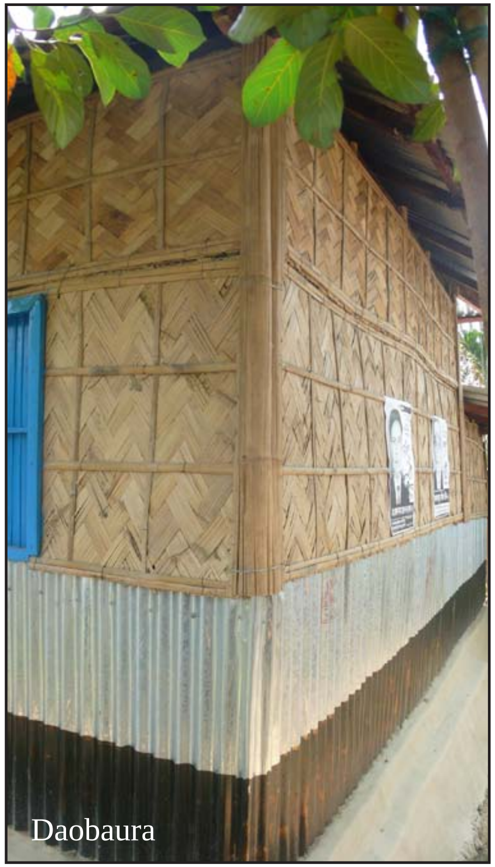


It protects the iron sheets (expensive) from rust and wear, in areas with a low risk of termites attack.

- Wall base protection -

mix wall : bamboo mat on zinc basement

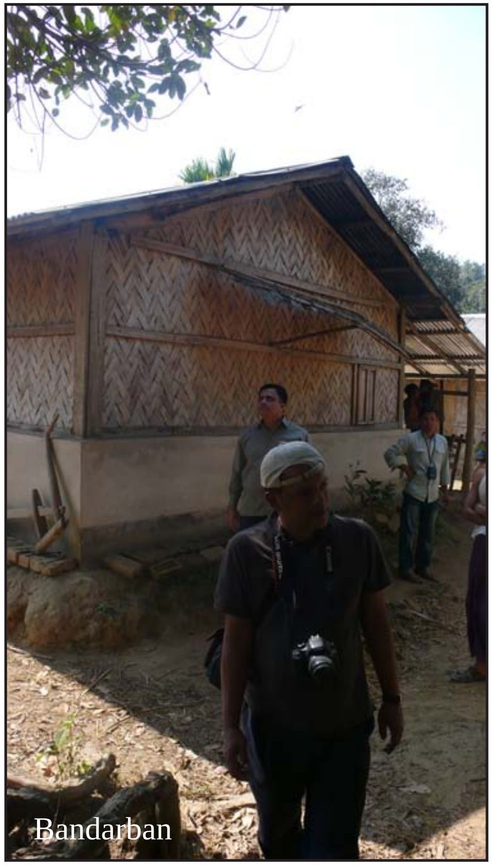

Daobaura

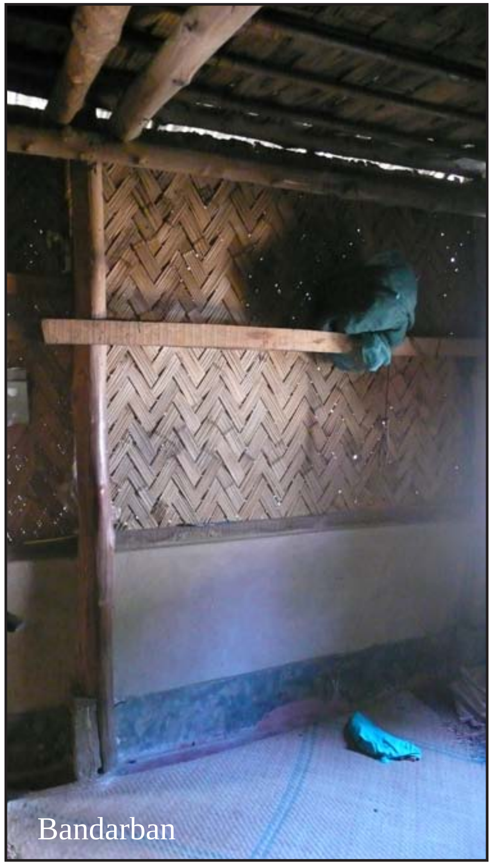

Daobaura

Iron sheet is put on the wall base beacause it is more resistant. Since it is an expensive materials and in order to avoid over heating of the room, it is used only for the base strip. This element can be replaced when wear.

- Wall base protection -

earth basement under bamboo wall

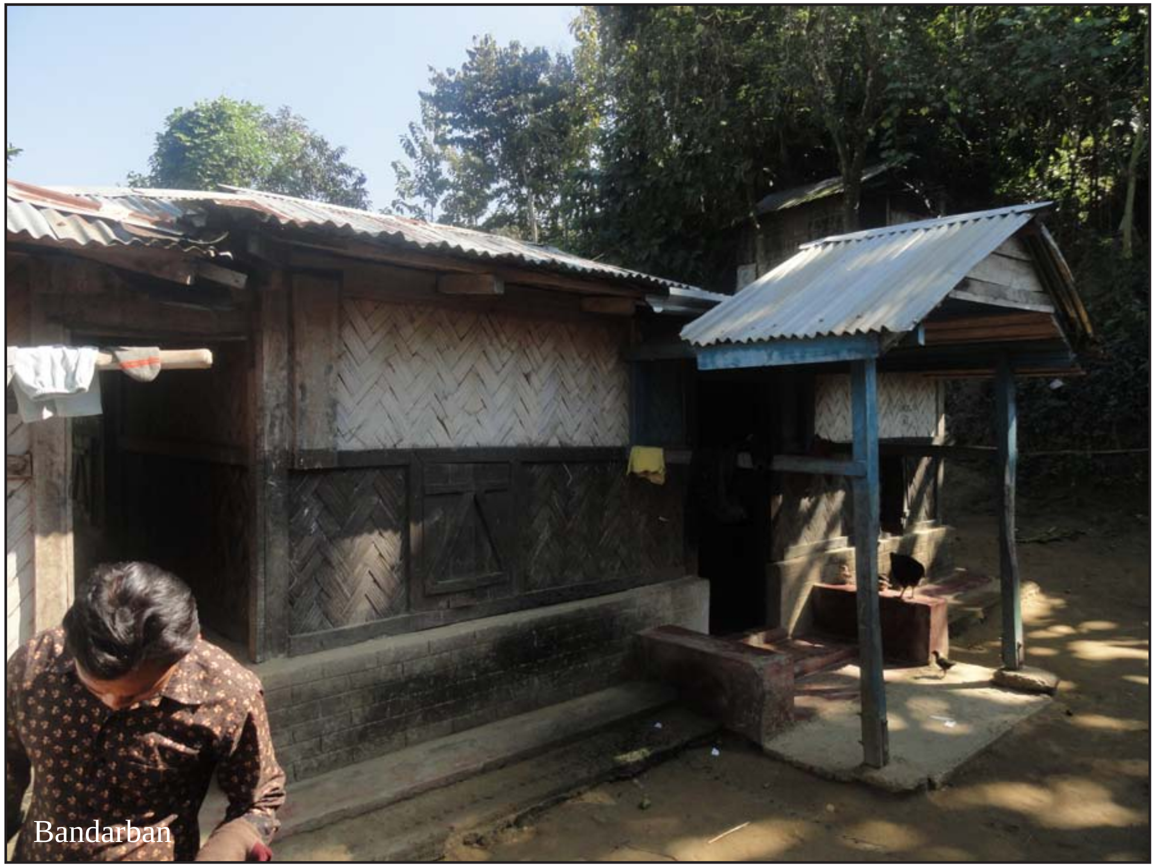


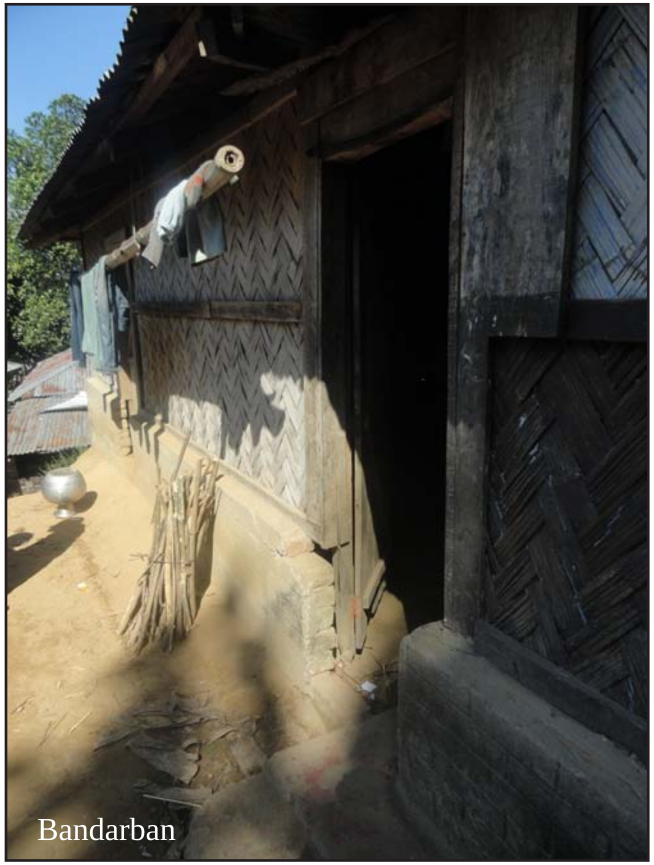


Sensible to water erosion and to moisture, earth walls are easy to maintain and cheap to repair.

- Wall base protection -

fired bricks basement under bamboo mat

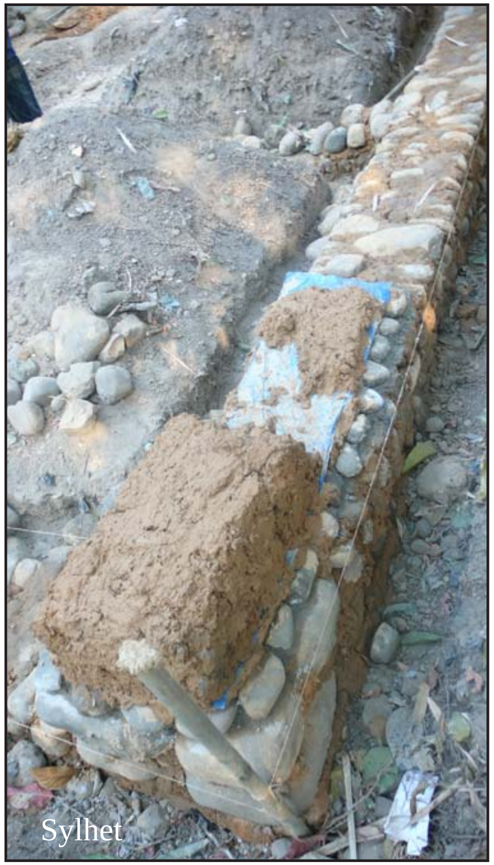




Fired bricks are more expensive, but a wall base made out with them can efficienly protect the wall.

- Wall base protection -

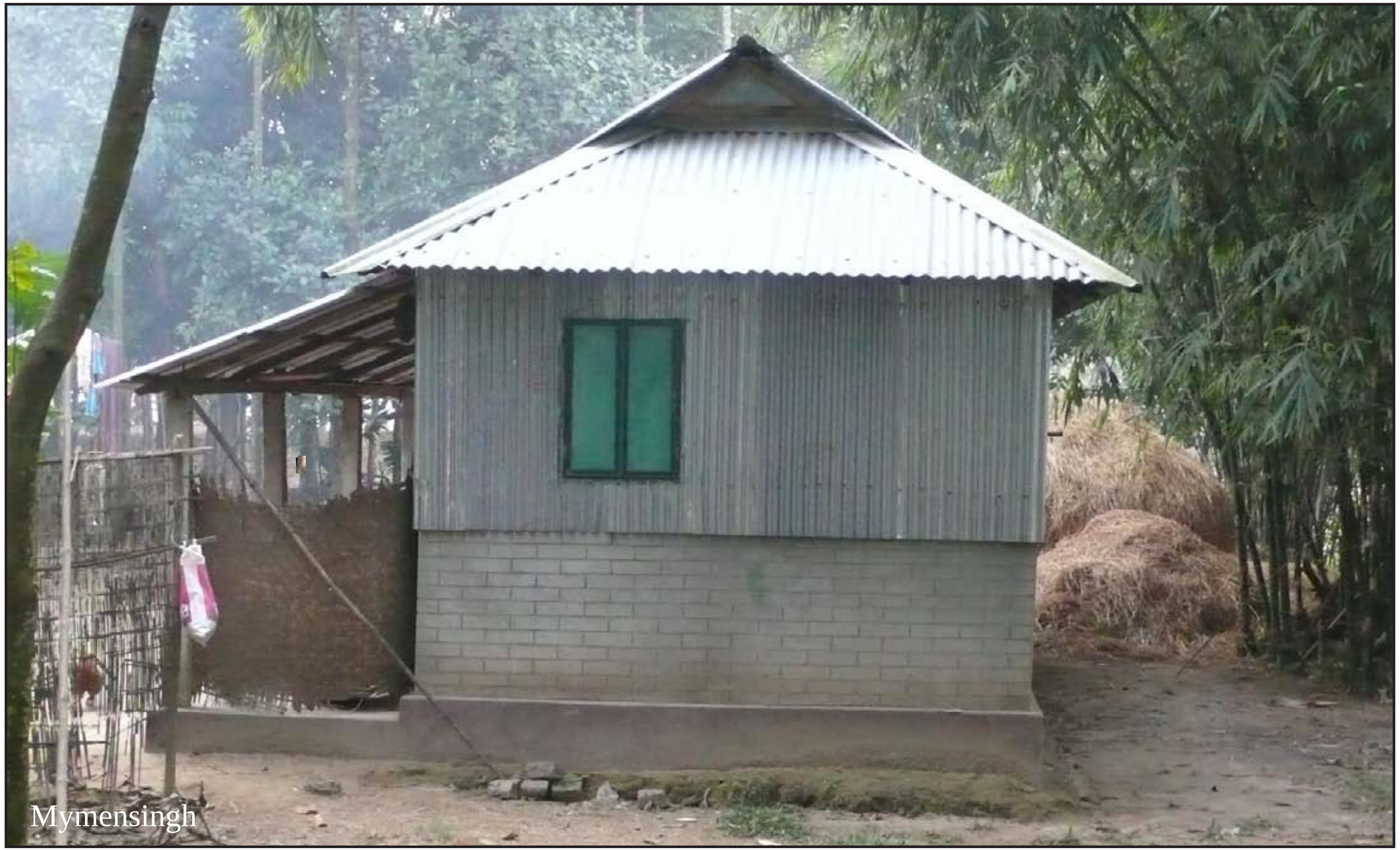
stone basement under cob wall



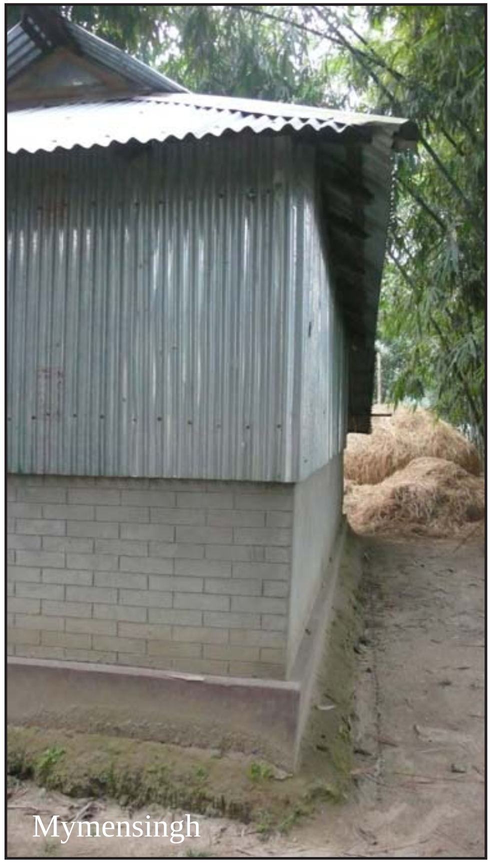
The footing made out of stones, built at a fitting height, ensures an efficient protection of the wall.

- Wall base protection -

fired bricks basement under zinc wall



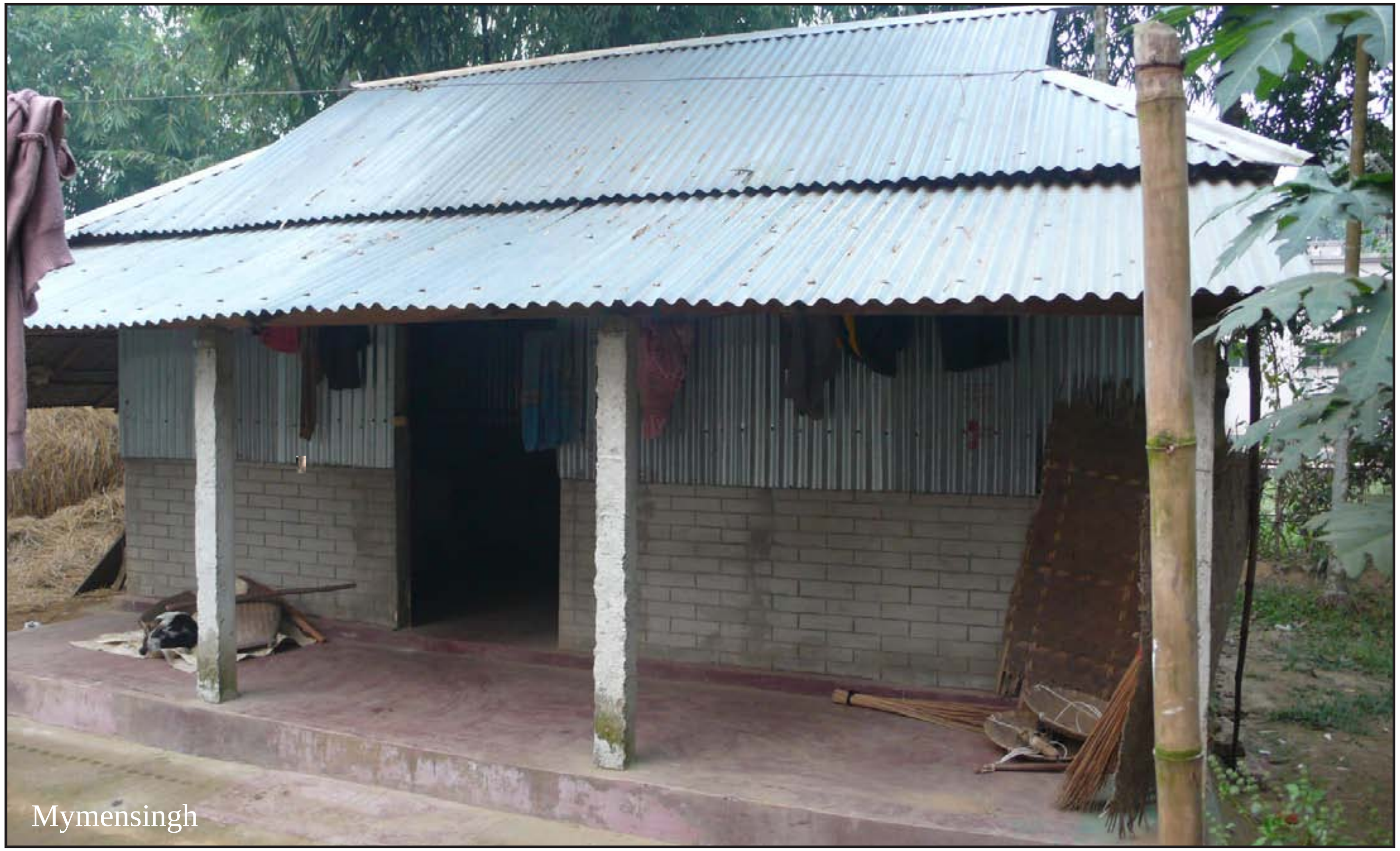
Mymensingh



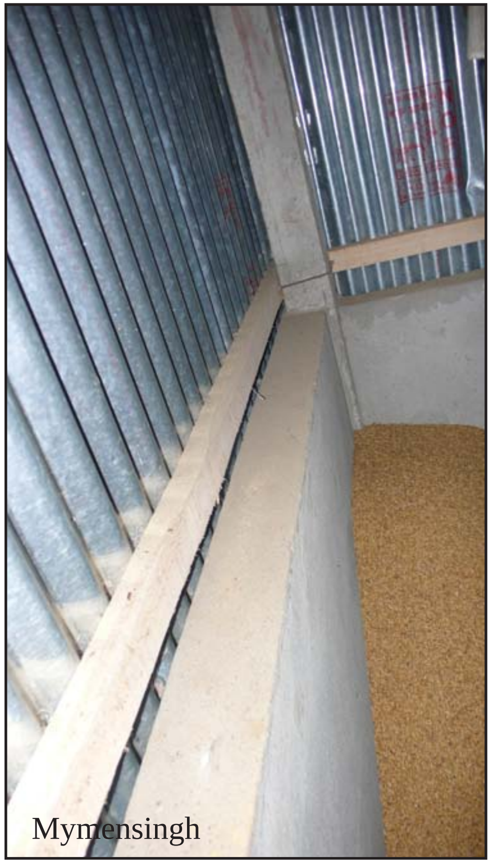
Mymensingh

- Wall base protection -

fired bricks basement under zinc wall



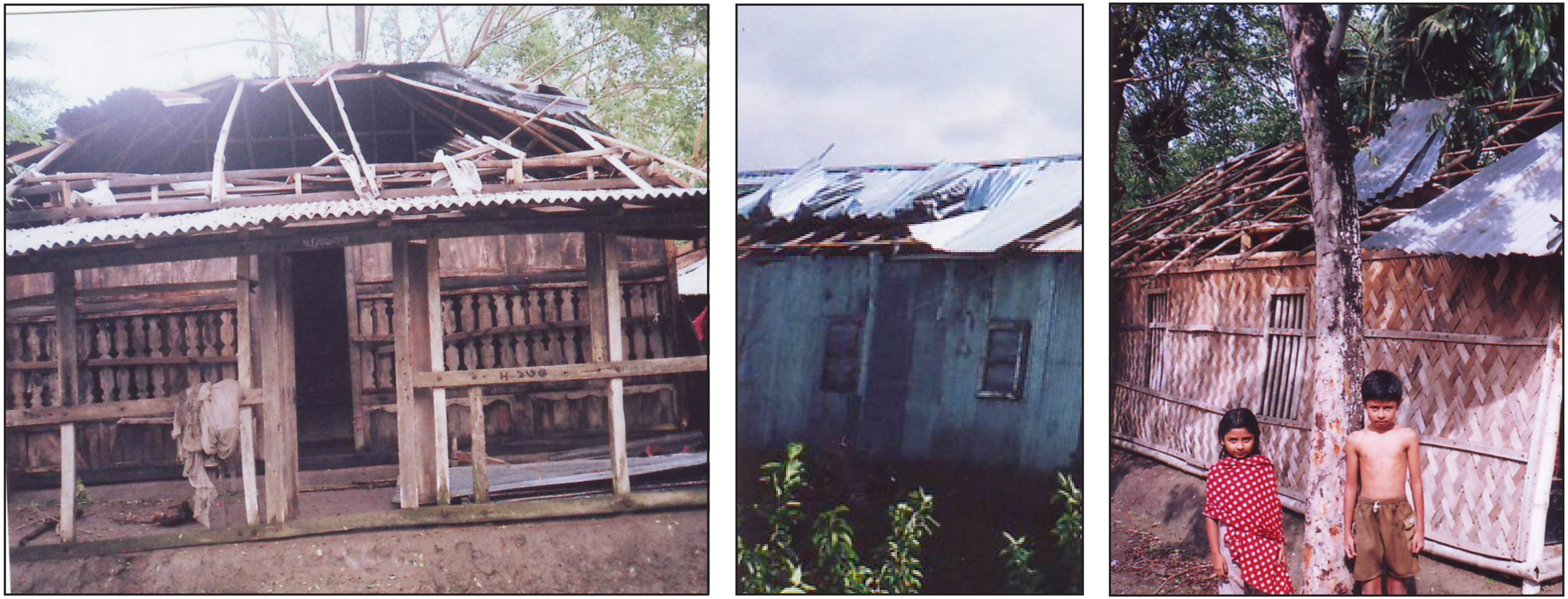
Mymensingh



Mymensingh

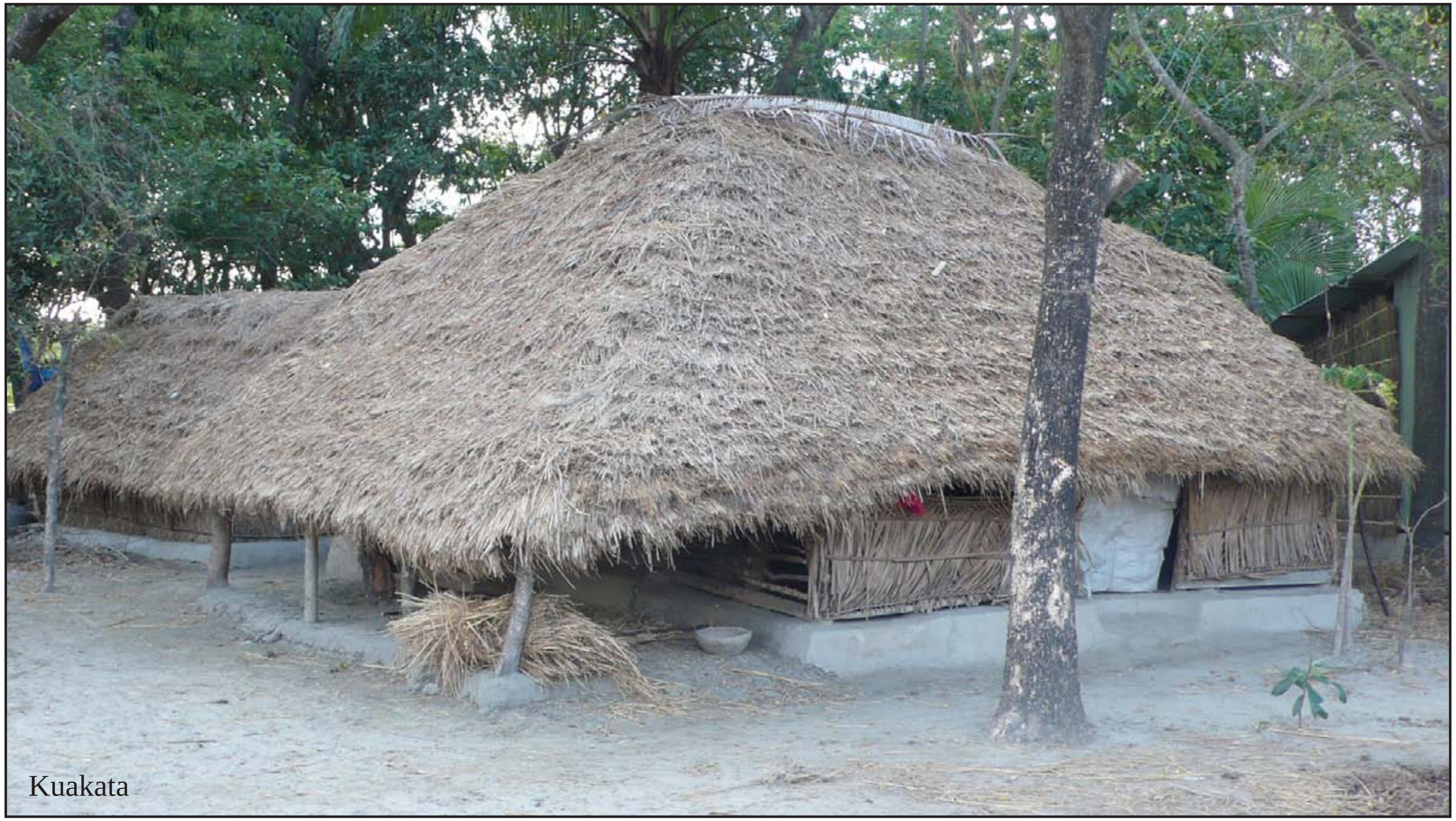
- STRONG WINDS -

Roof : cover wrenching



- Protection against cover wrenching -

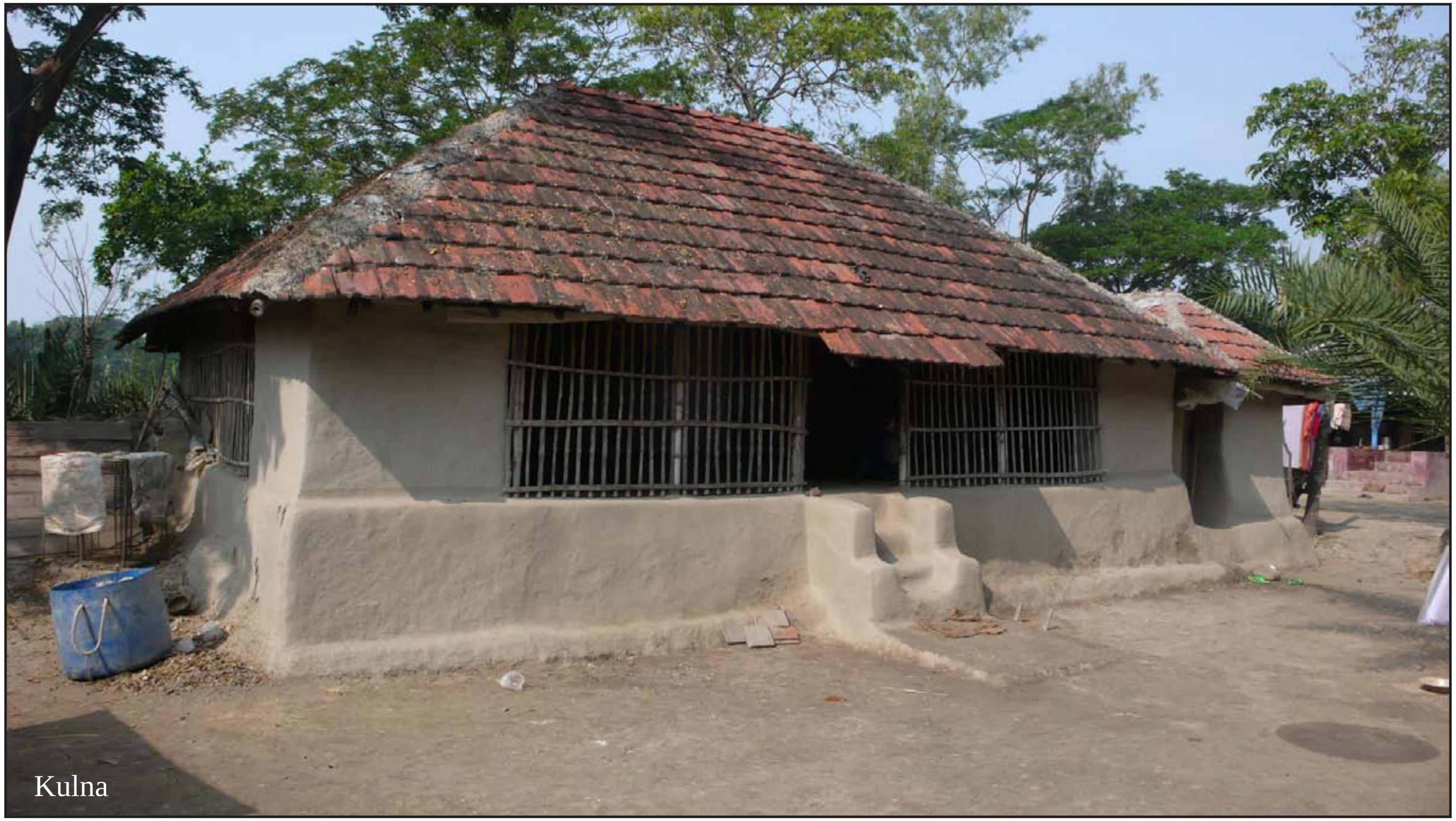
green roof



Some elements of a green roof can get damaged and/or pulled out by the wind, without making the roof to collapse.

- Protection against cover wrenching -

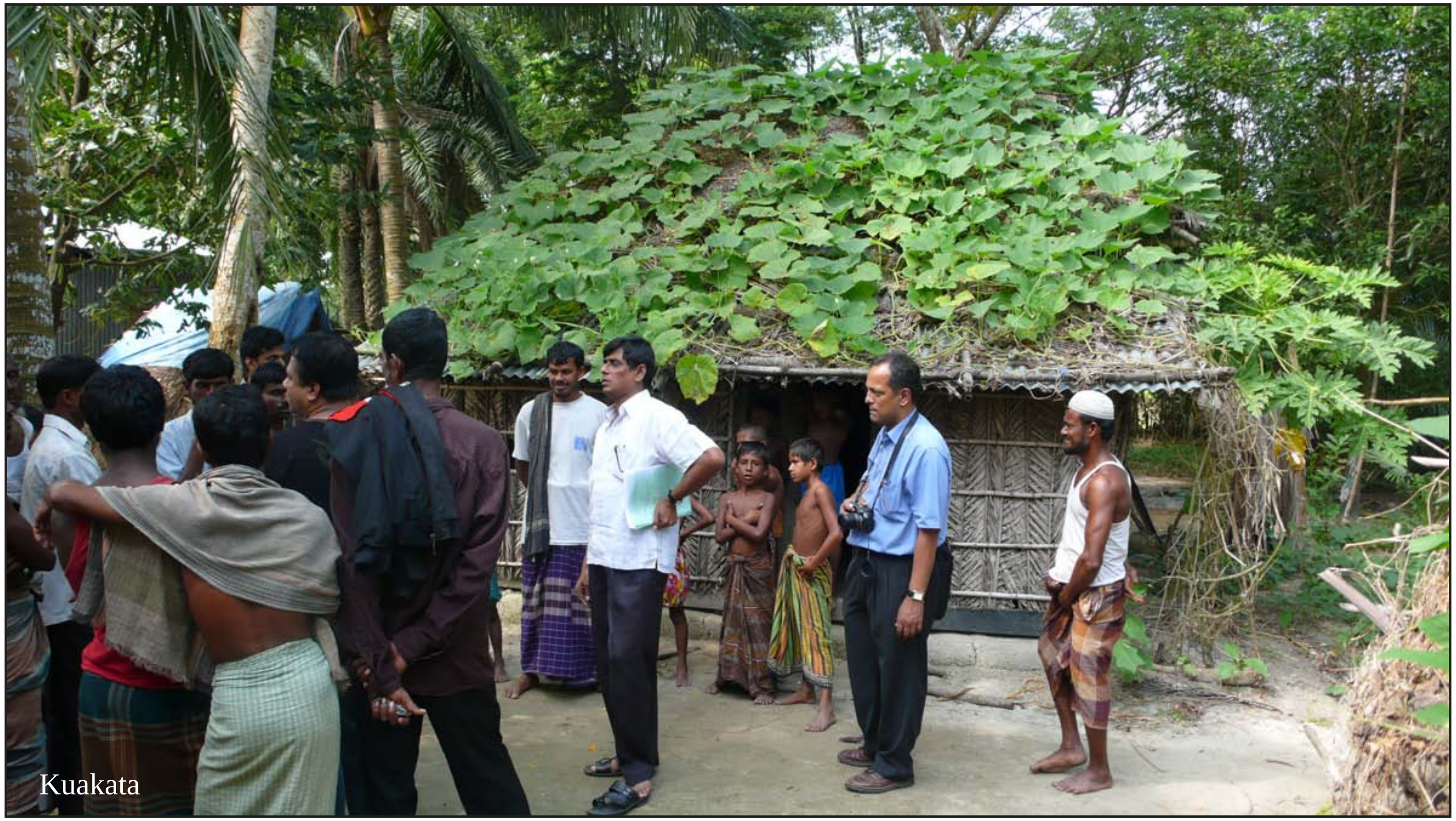
tile roof


Kulna

Some elements of a tile roof can get damaged and/or pulled out by the wind, without making the roof to collapse.

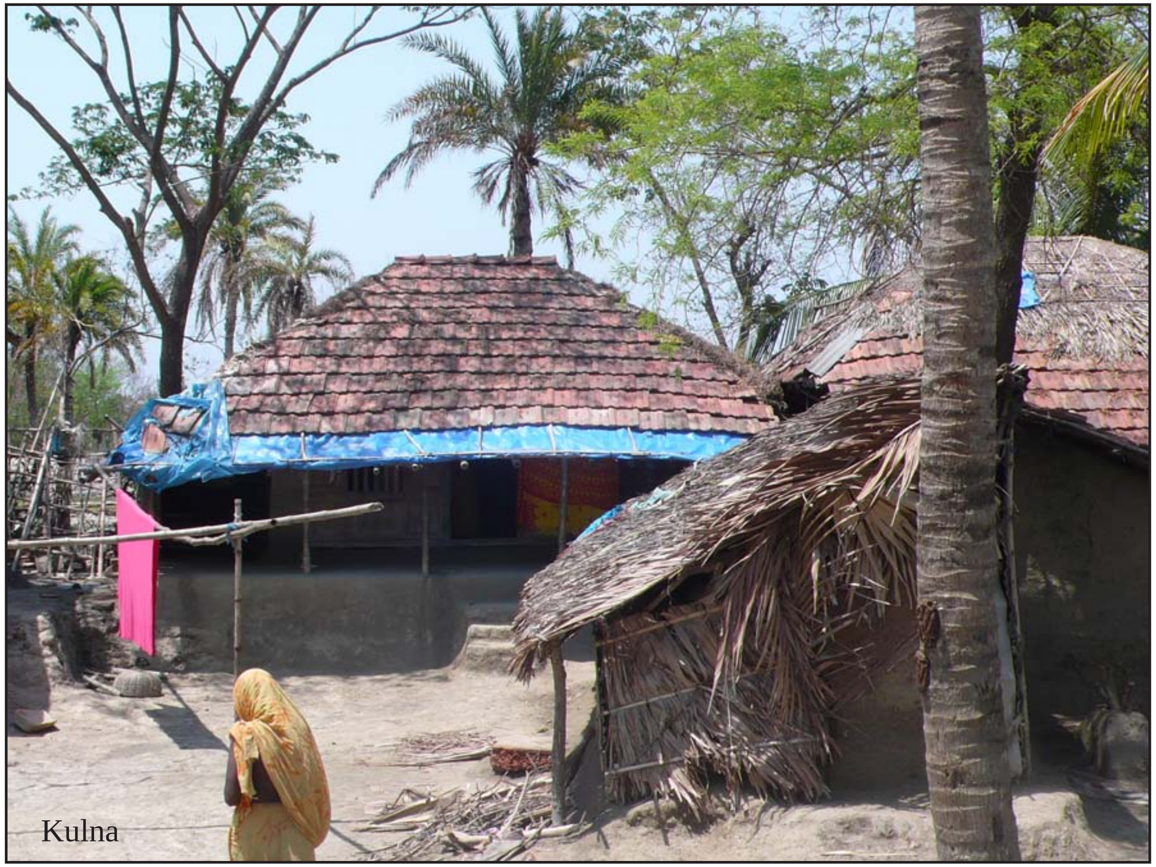
- Protection against cover wrenching -

cover fastening with plant vines



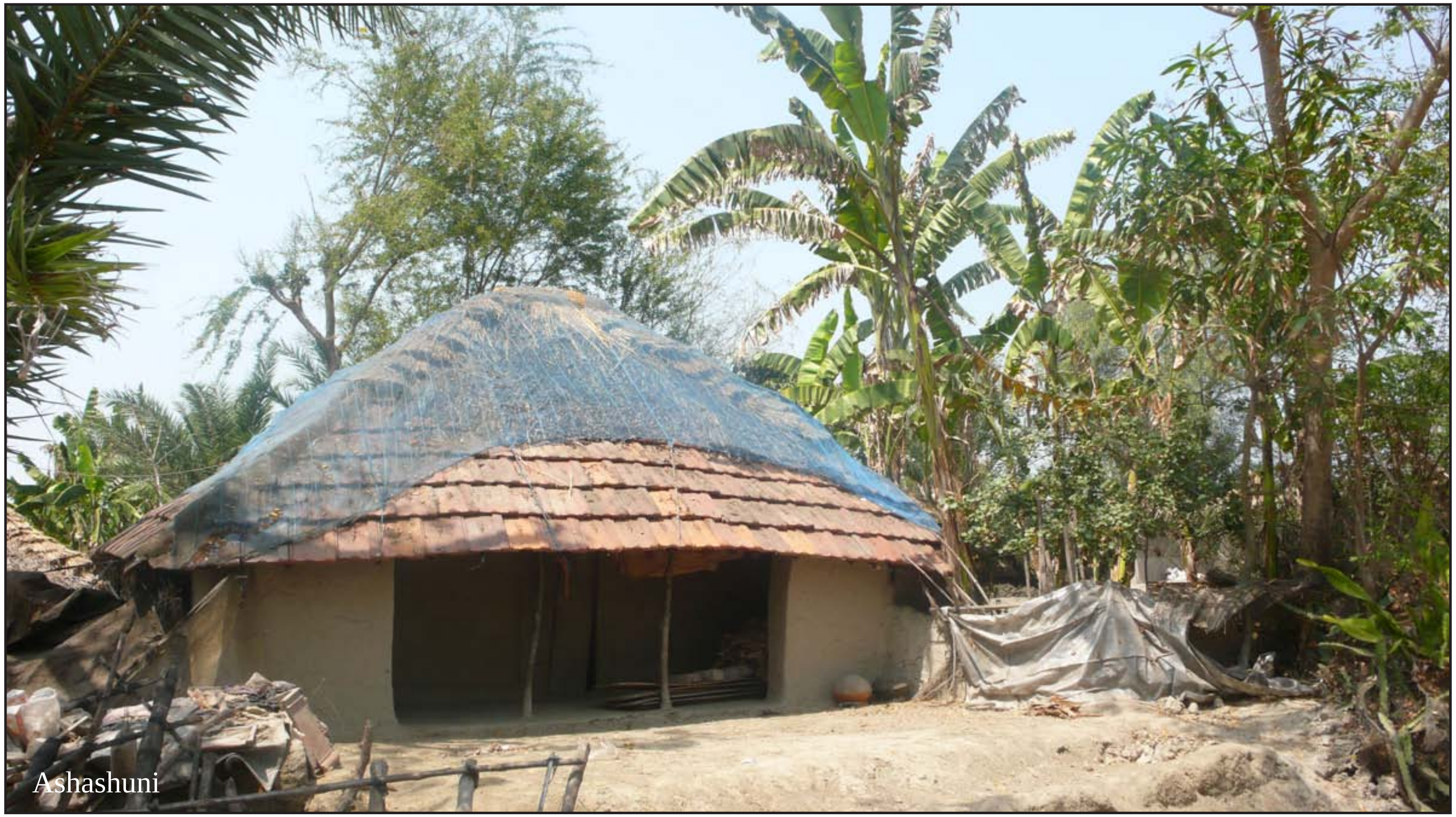
- Protection against cover wrenching -

eaves protection with an enveloping plastic sheet



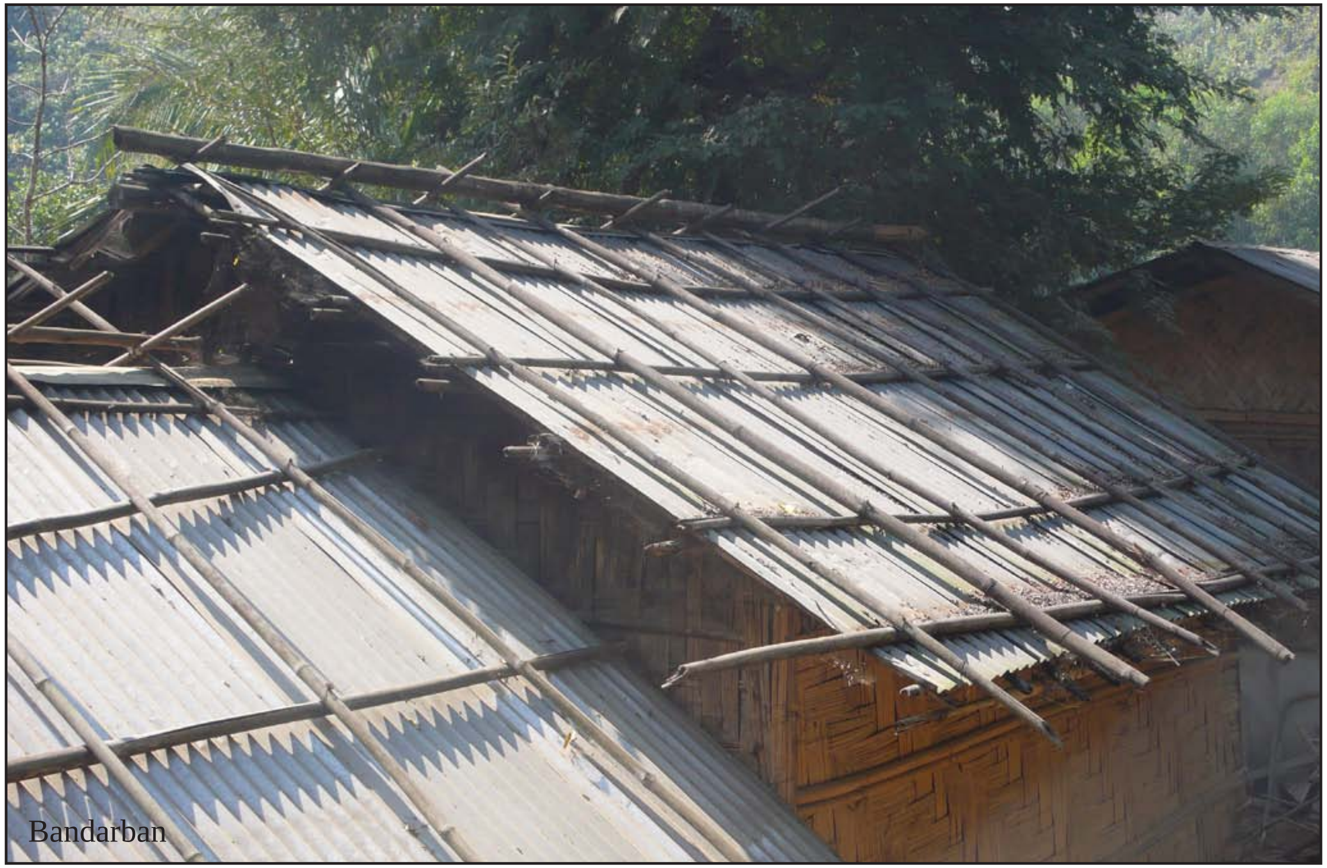
- Protection against cover wrenching -

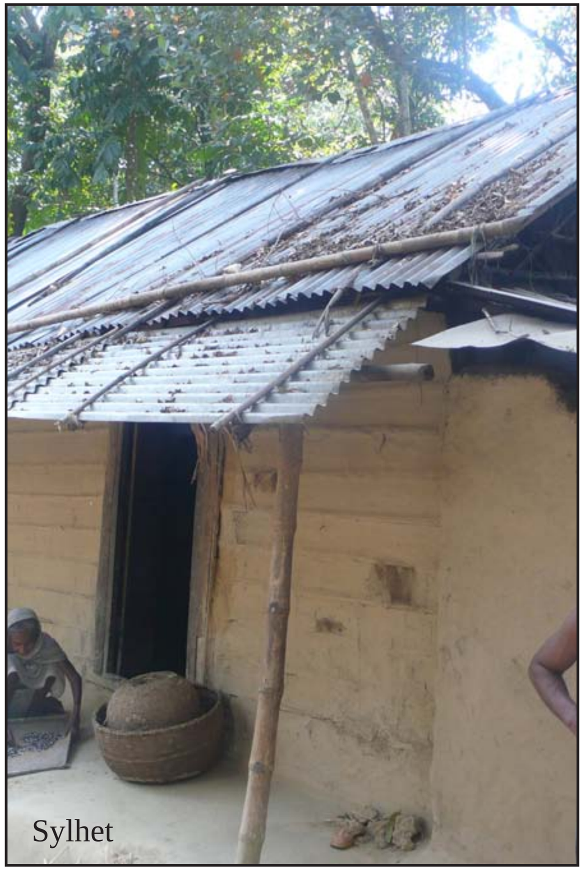
cover fastening with net



- Protection against cover wrenching -

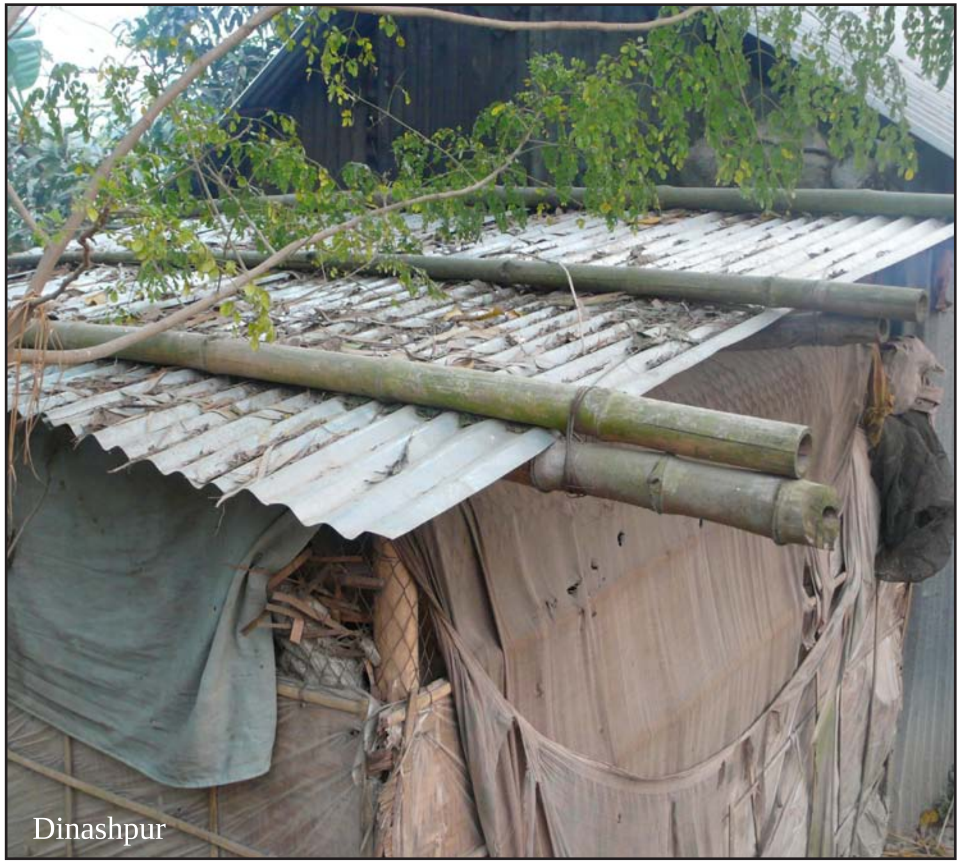
cover fastening with bambous

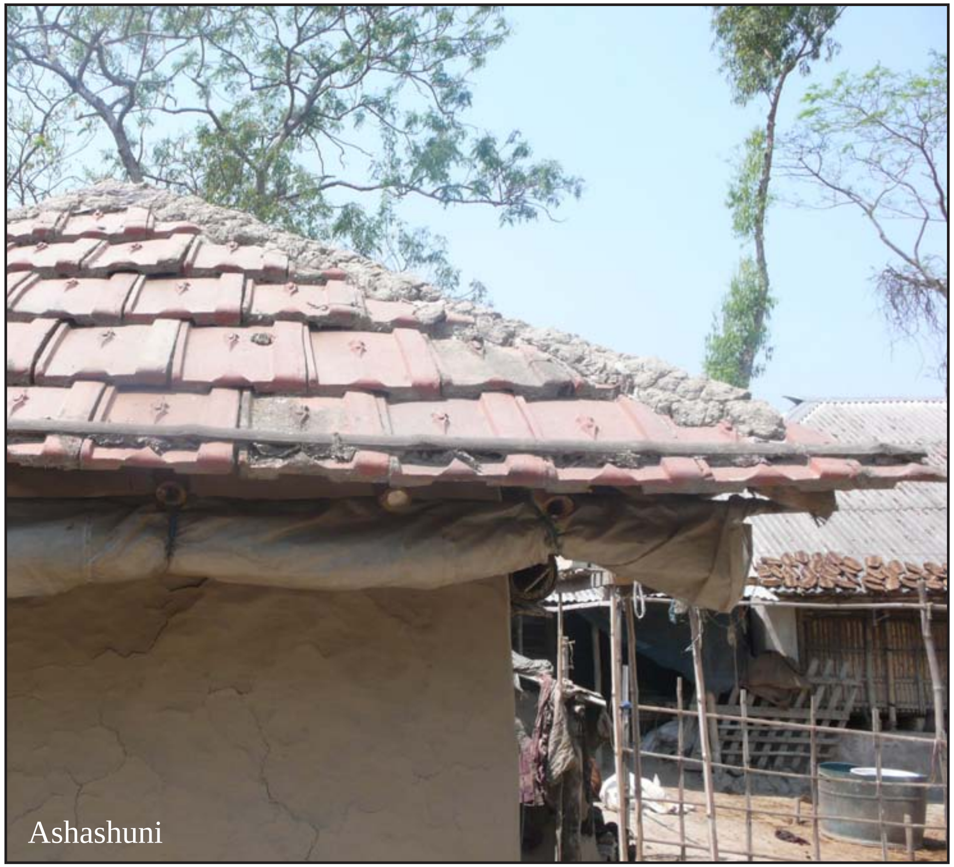

Bandarban


Sylhet

- Protection against cover wrenching -

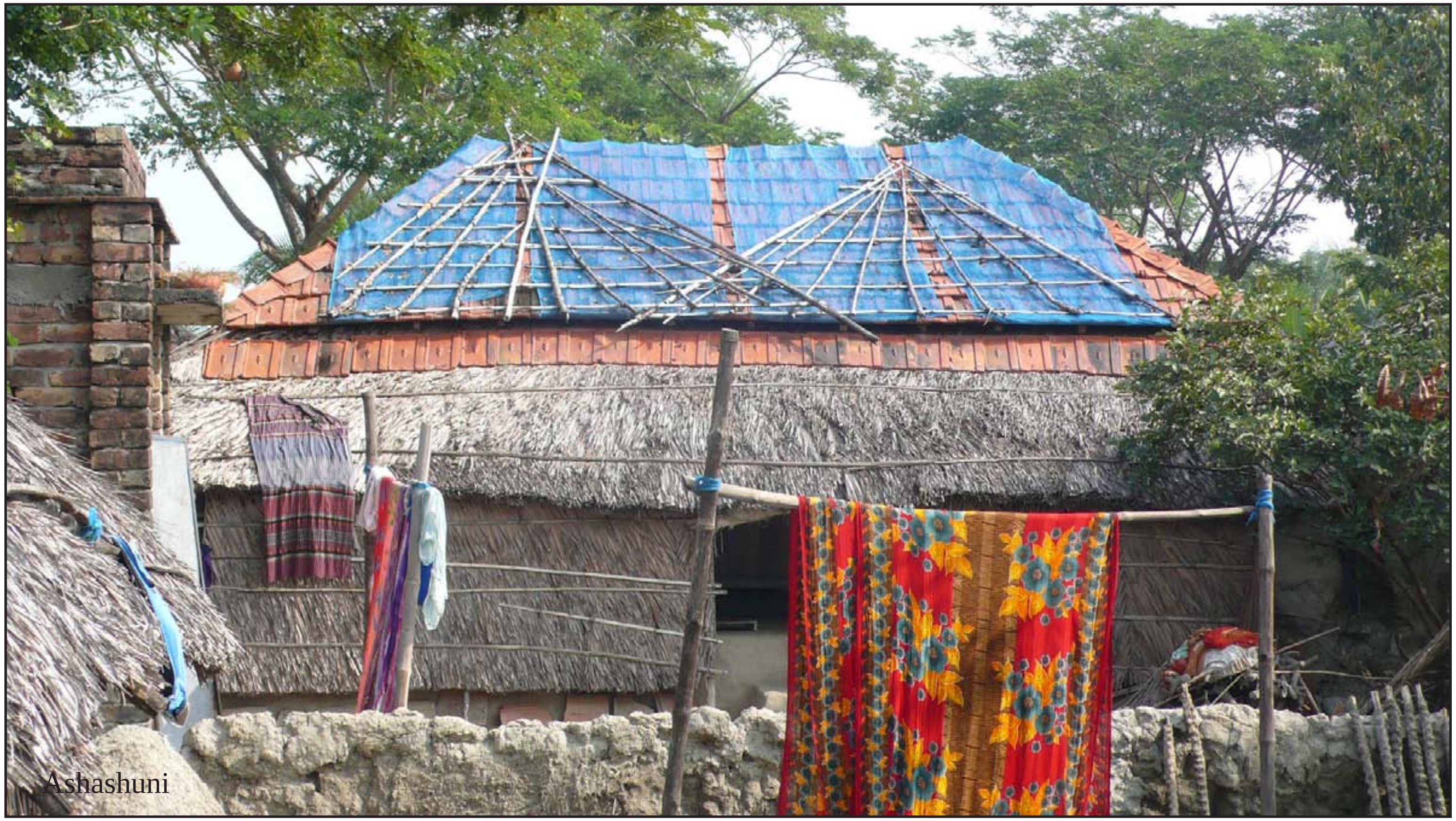
cover fastening with bambous


Dinashpur


Ashashuni

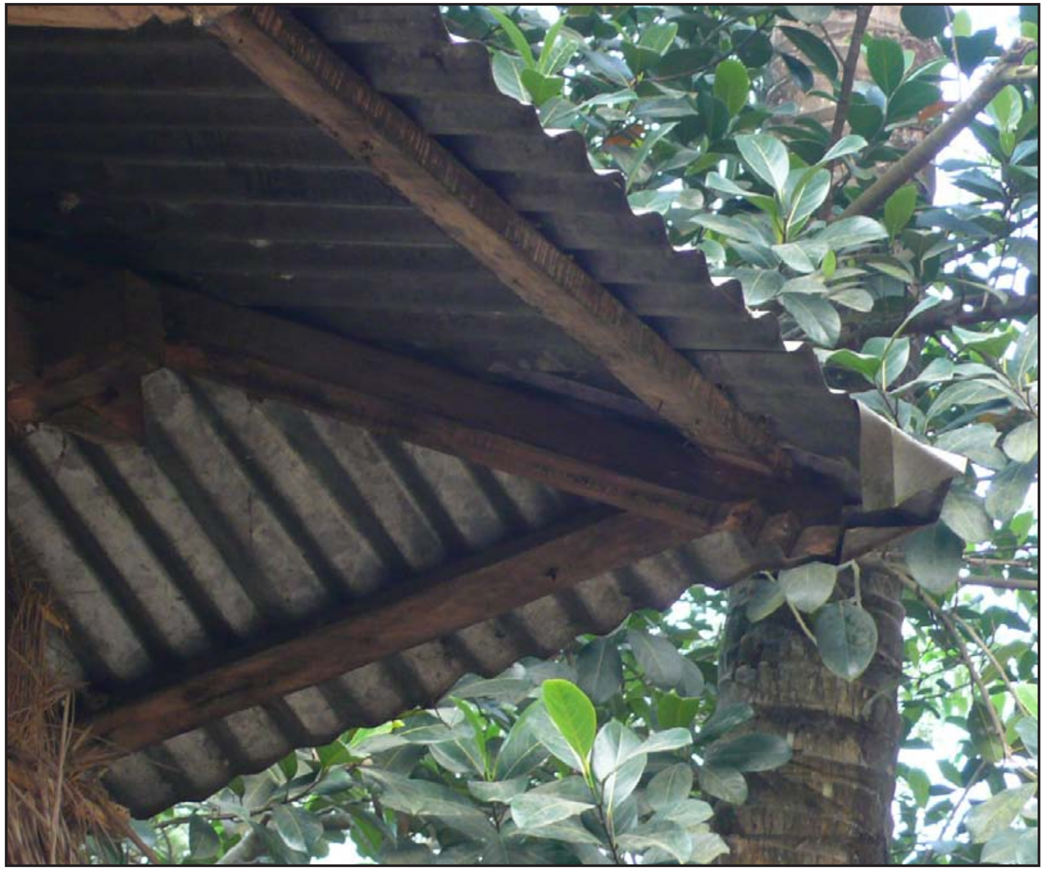
- Protection against cover wrenching -

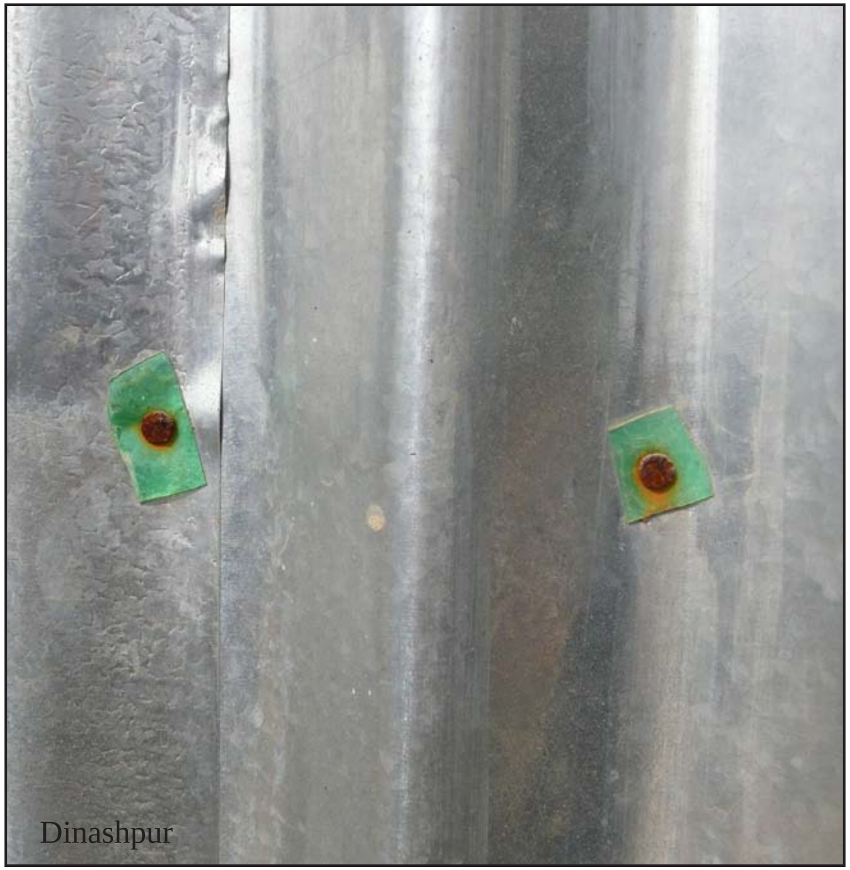
cover fastening with net + bambous



- Protection against cover wrenching -

proper iron sheet fixing

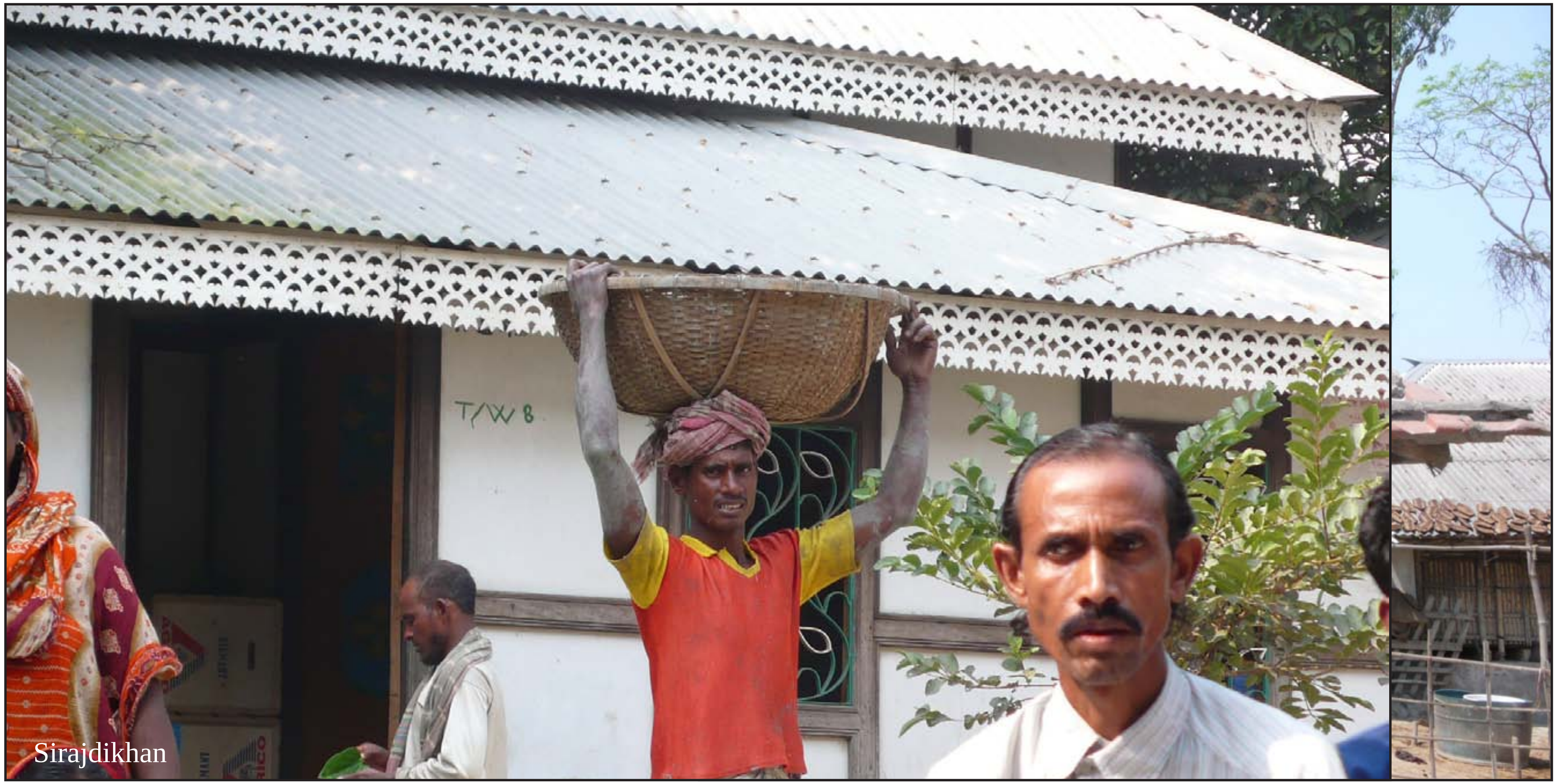




Adequate amount of nails, nails anti-rip reinforcement, sheets jonctions at the corners.

- Protection against cover wrenching -

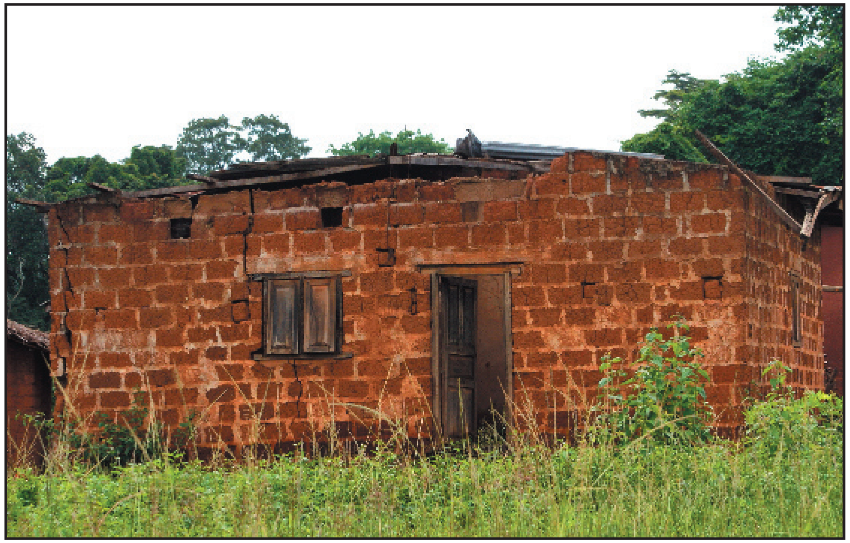
graven barge board

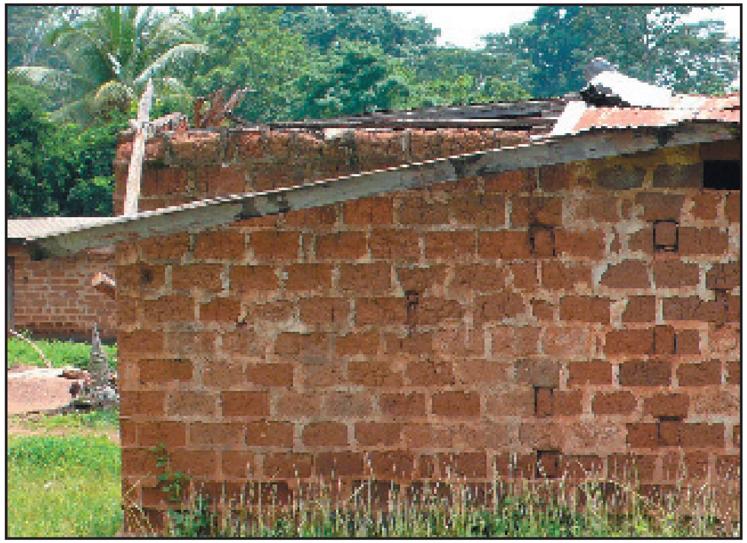


Wind strenght reduction.

- STRONG WINDS -

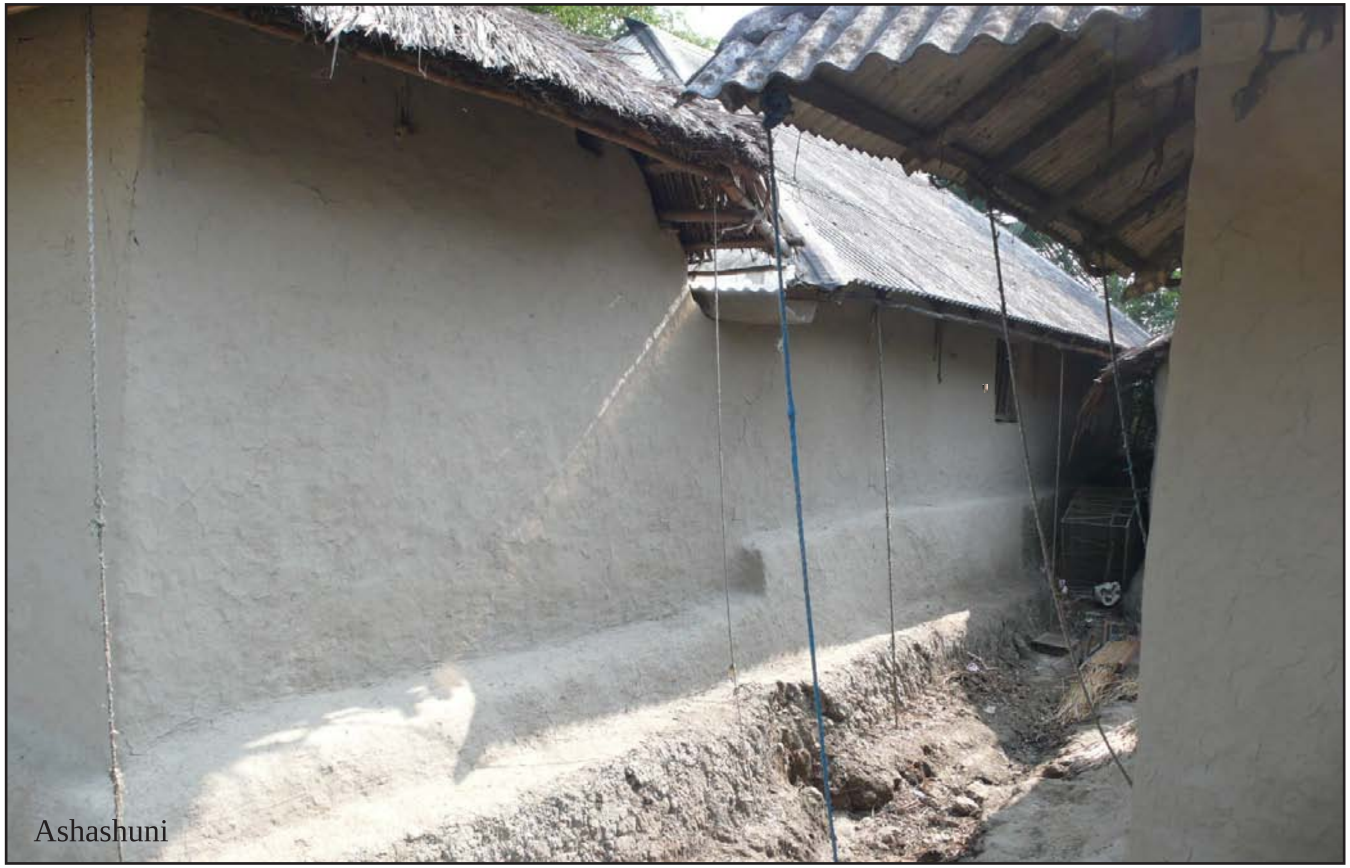
Roof wrenching

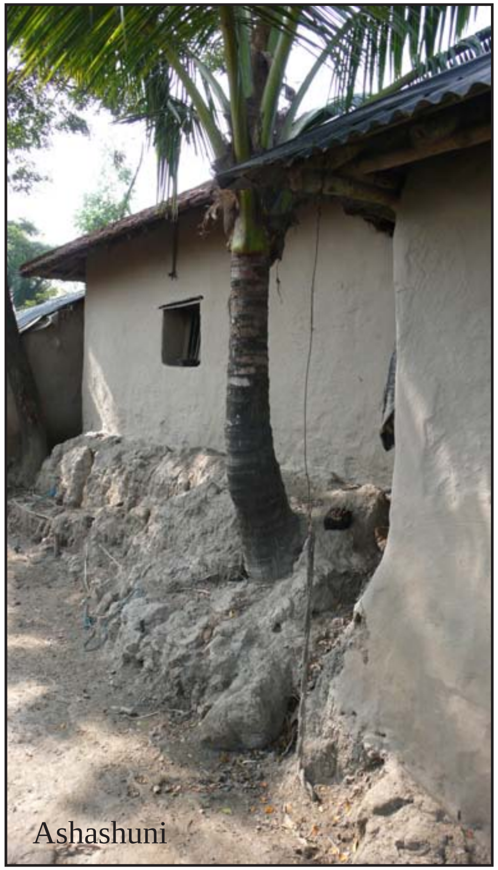




- Protection against roof wrenching -

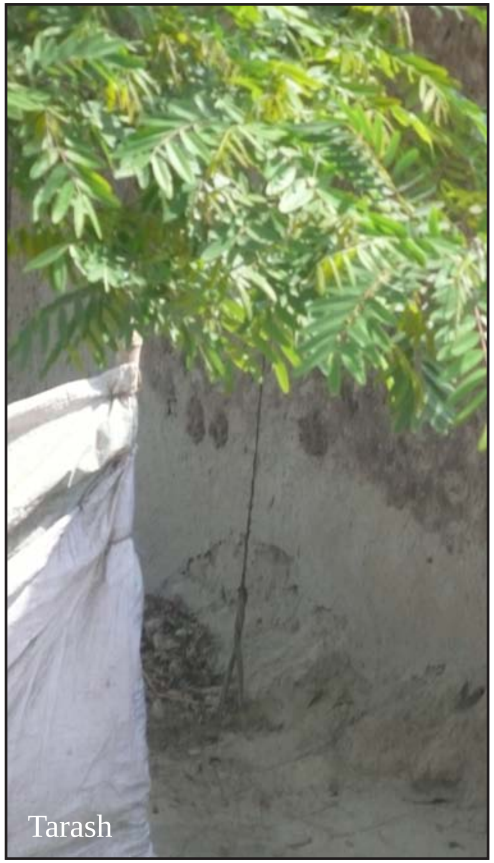
roof anchorings in the ground



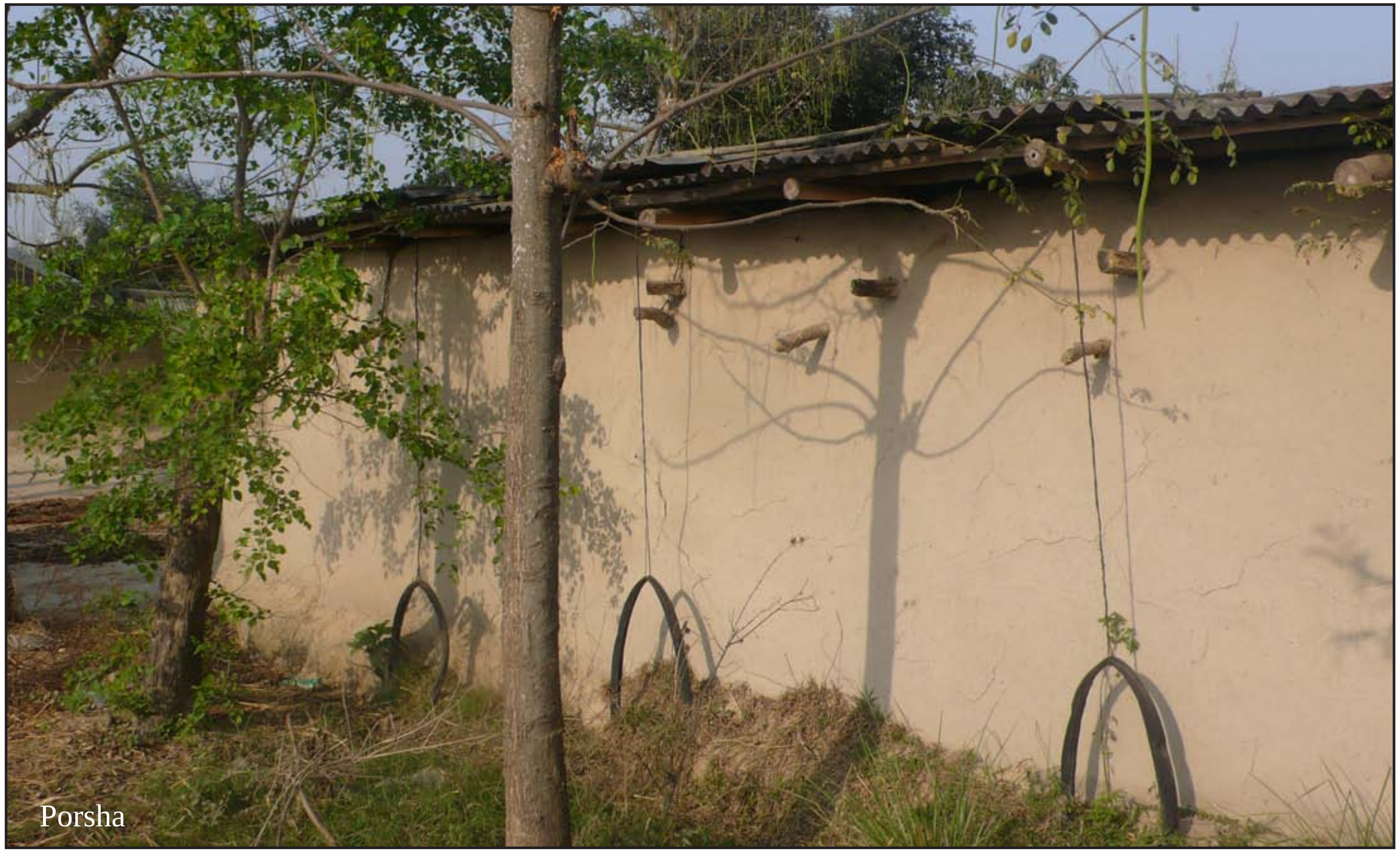


- Protection against roof wrenching -

roof anchorings in the ground by tyres



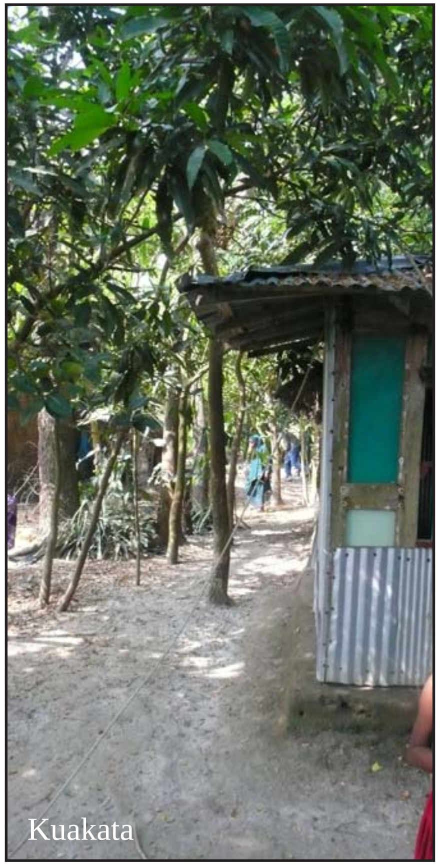
Tarash

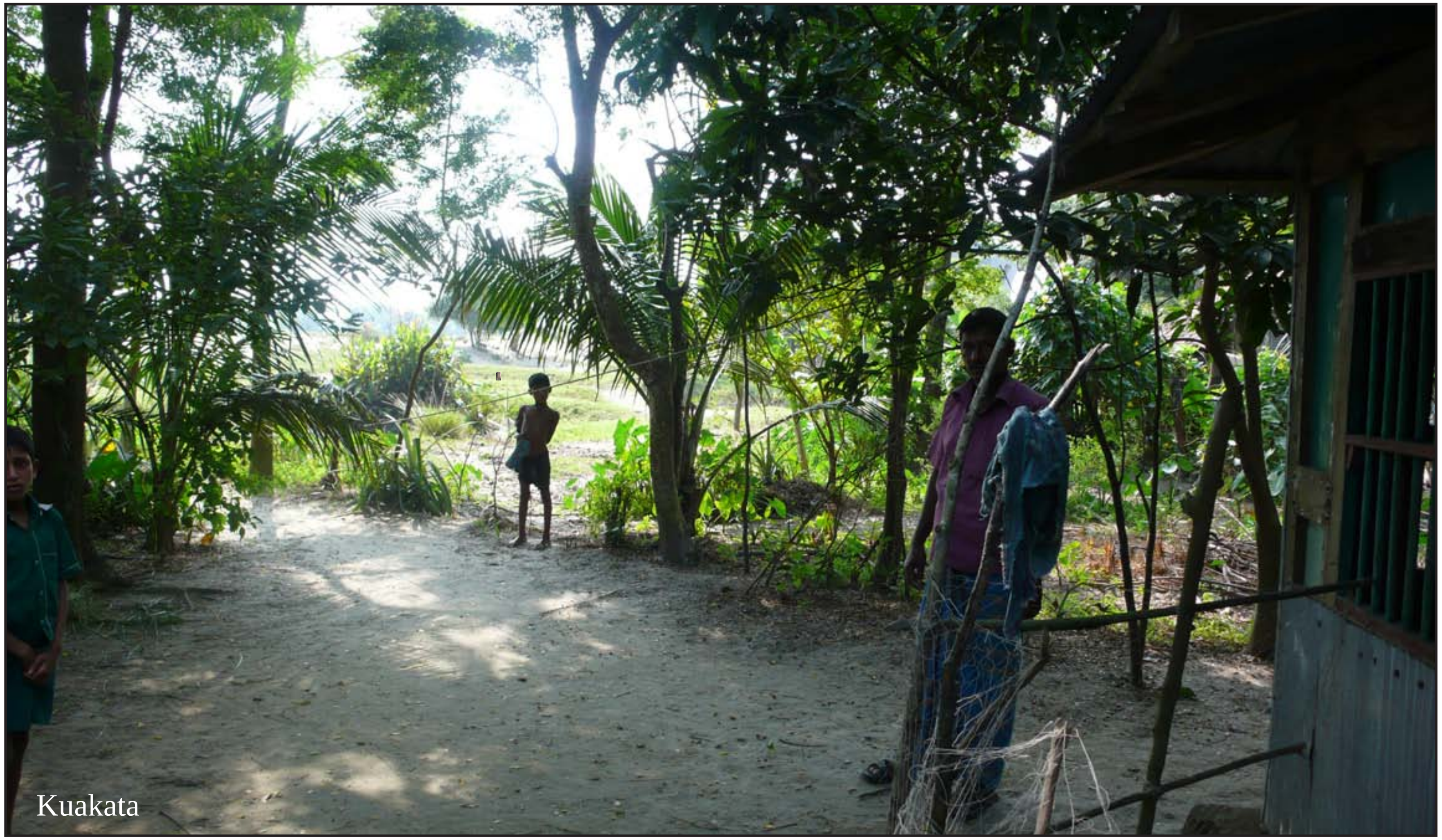


Porsha

- Protection against roof wrenching -

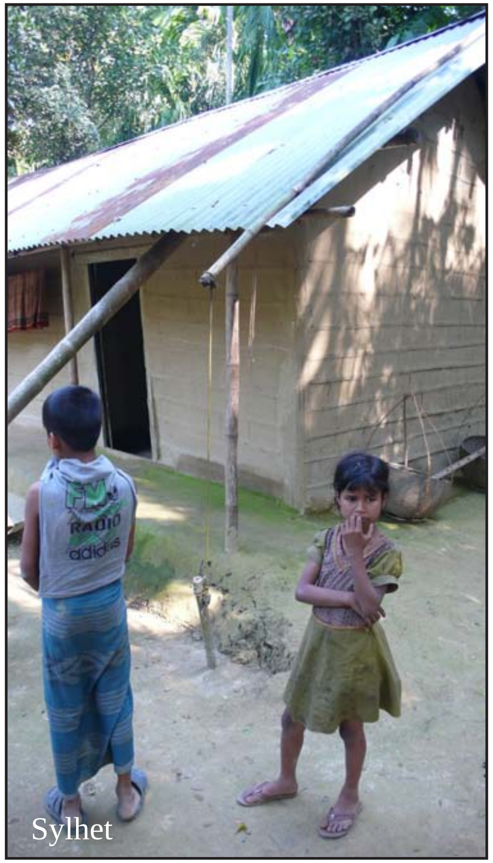
roof anchorings on surrounding trees


Kuakata


Kuakata

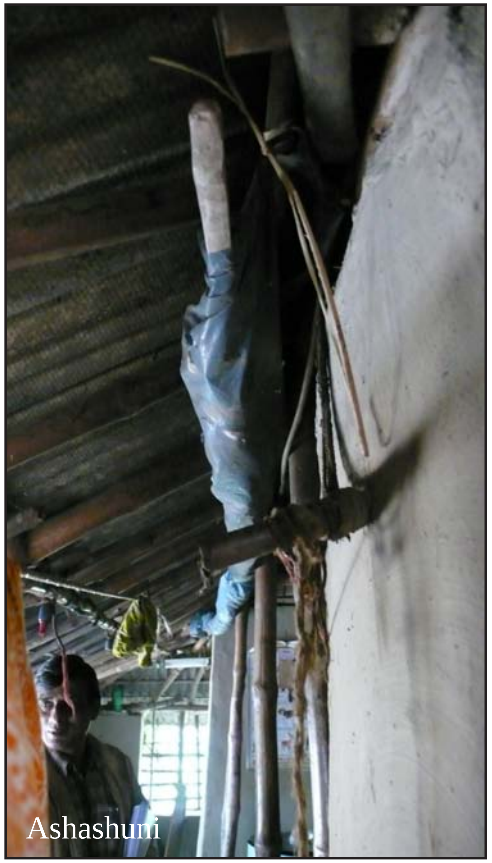
- Protection against roof wrenching -

roof anchorings in the ground by small stakes



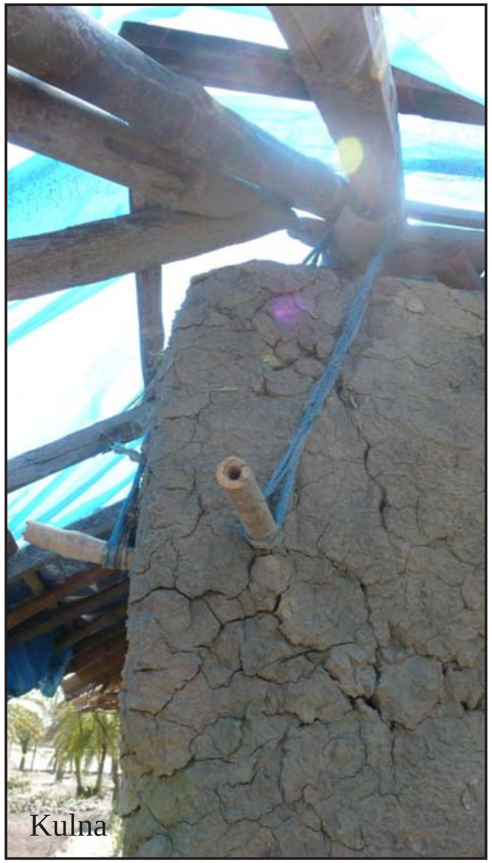
- Protection against roof wrenching -

light roof anchorings in the wall



Ashashuni

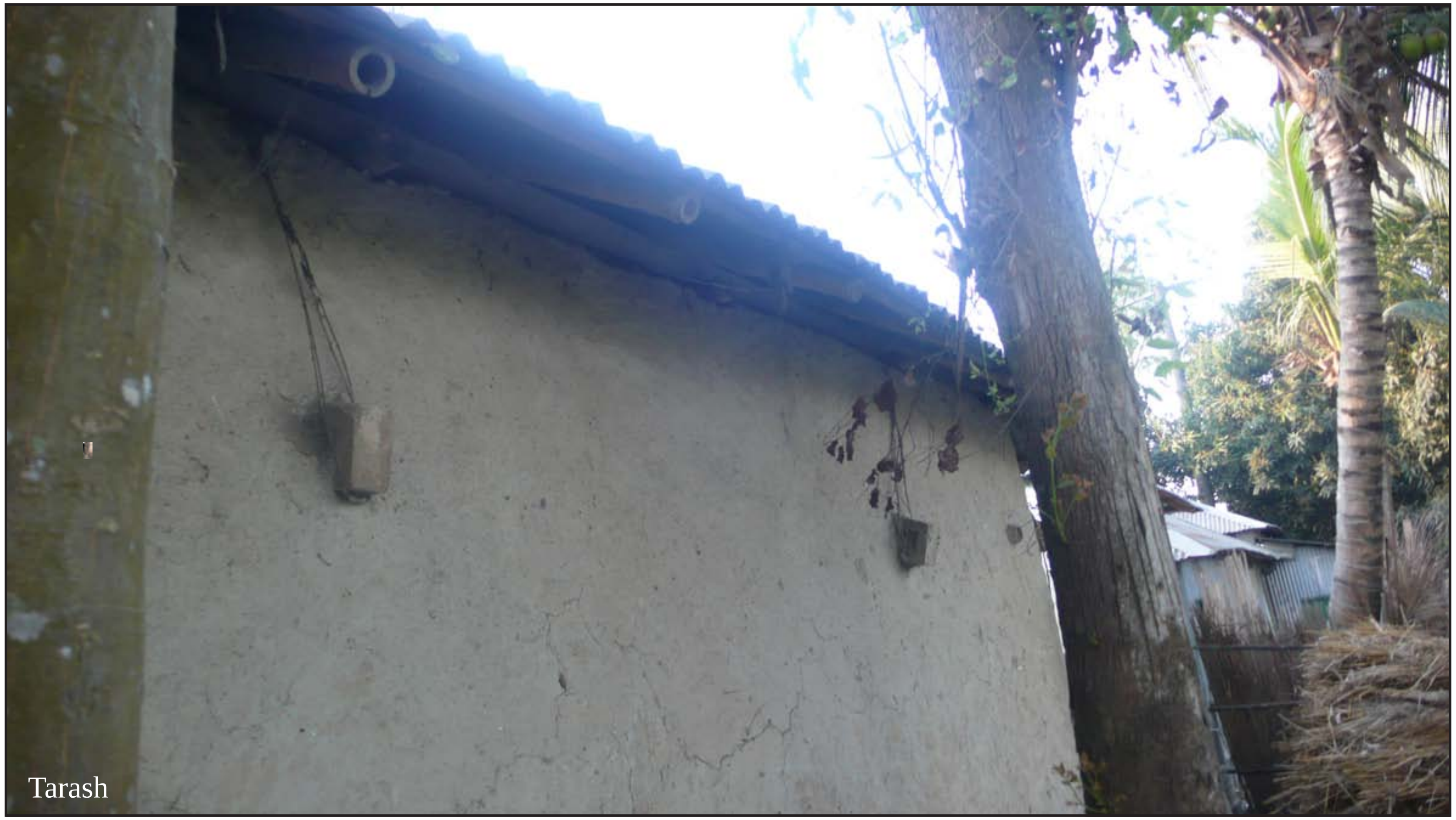
Mymensingh



Kulna

- Protection against roof wrenching -

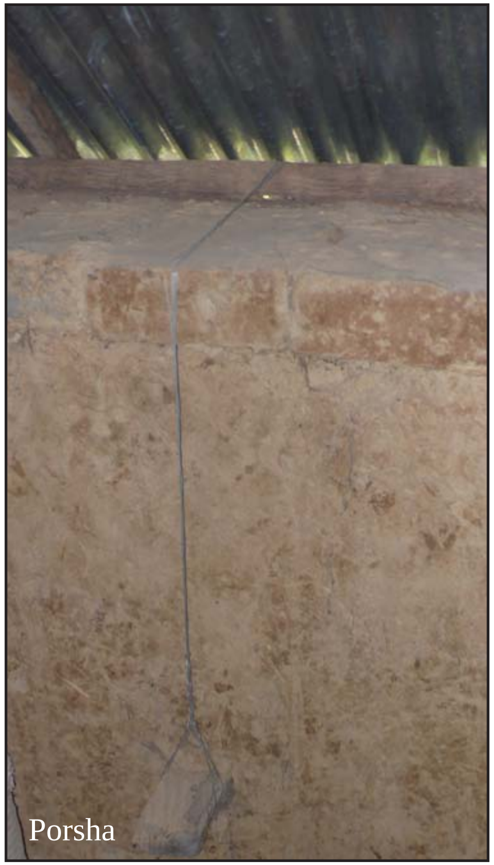
light roof anchorings in the wall by fired bricks



Tarash

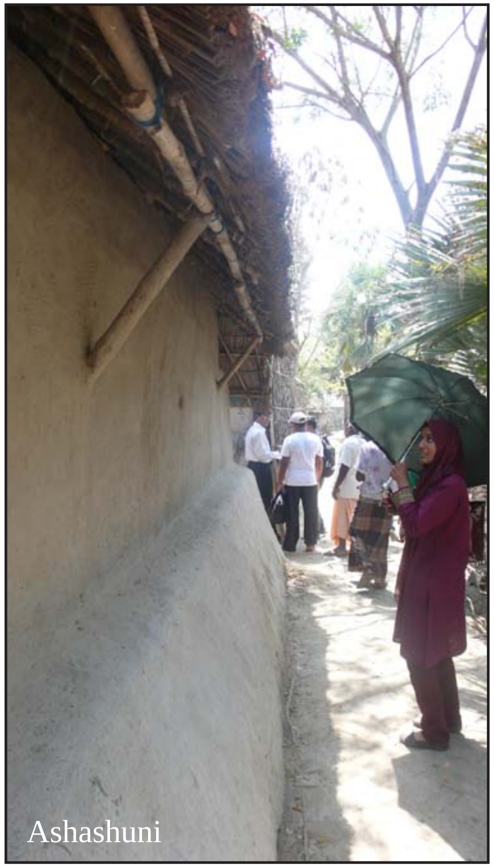
- Protection against roof wrenching -

light roof anchorings in the wall with protection of the top of the wall

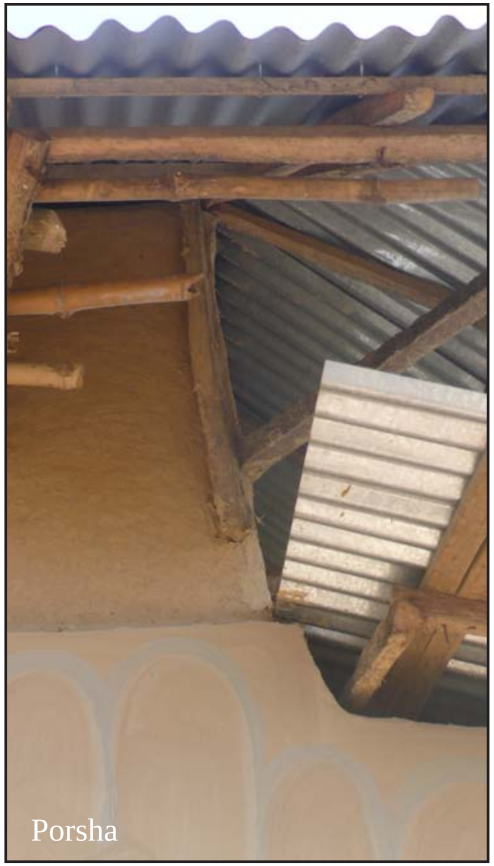


- Protection against roof wrenching -

wooden roof anchorings in the wall

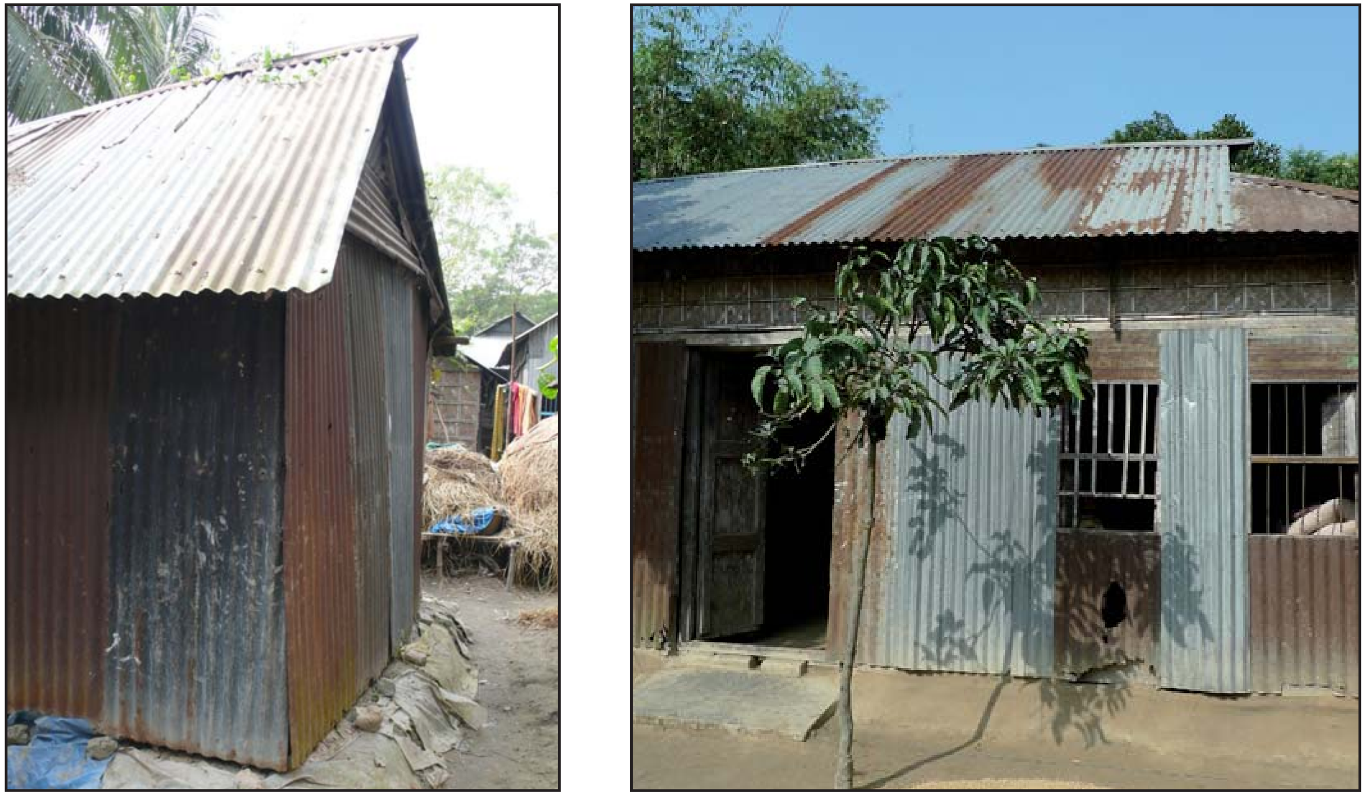


Ashashuni



Porsha

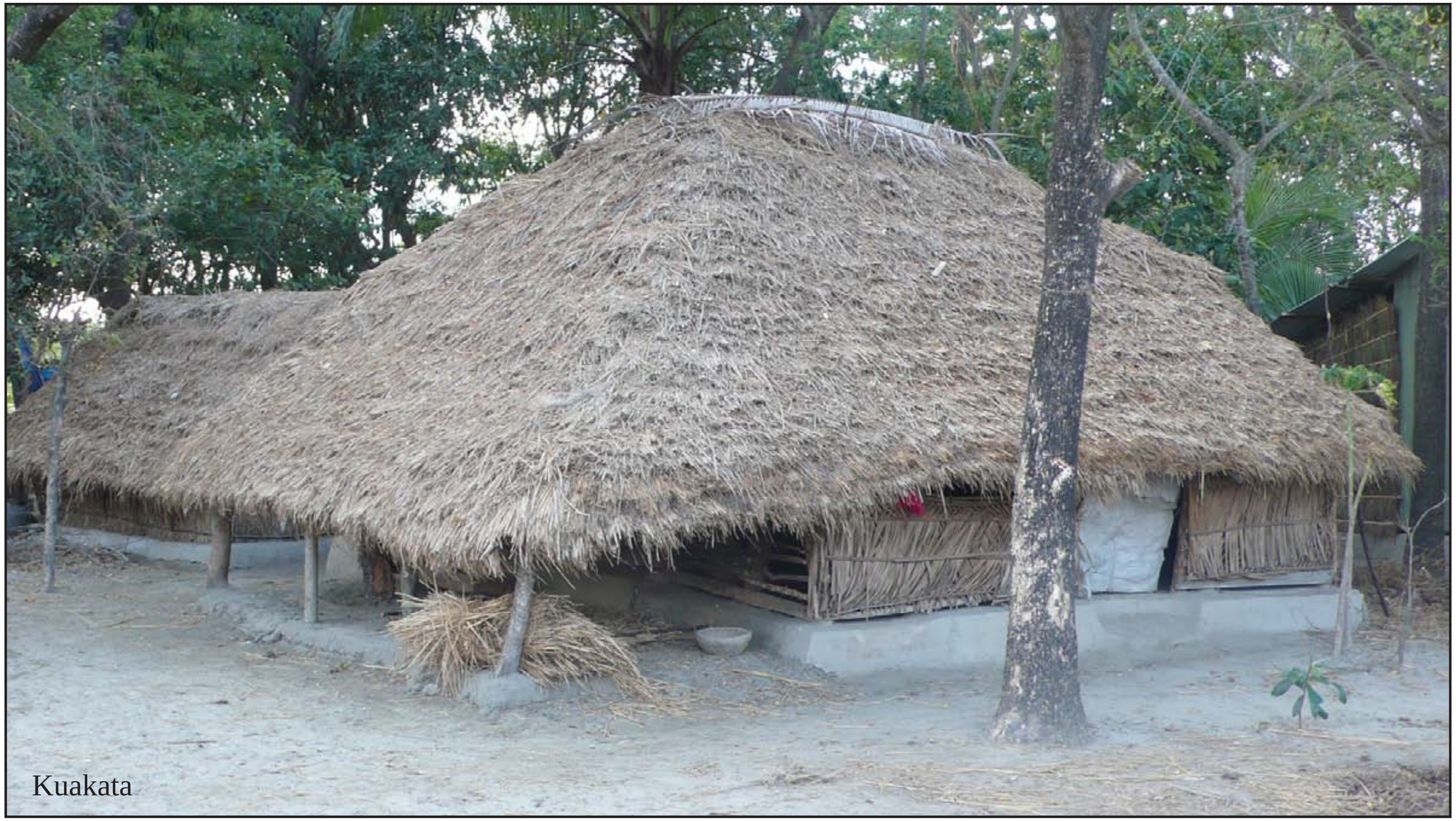
- SALTY ENVIRONMENT -



Acceleratd rust of iron sheets.

- Protection against salinity -

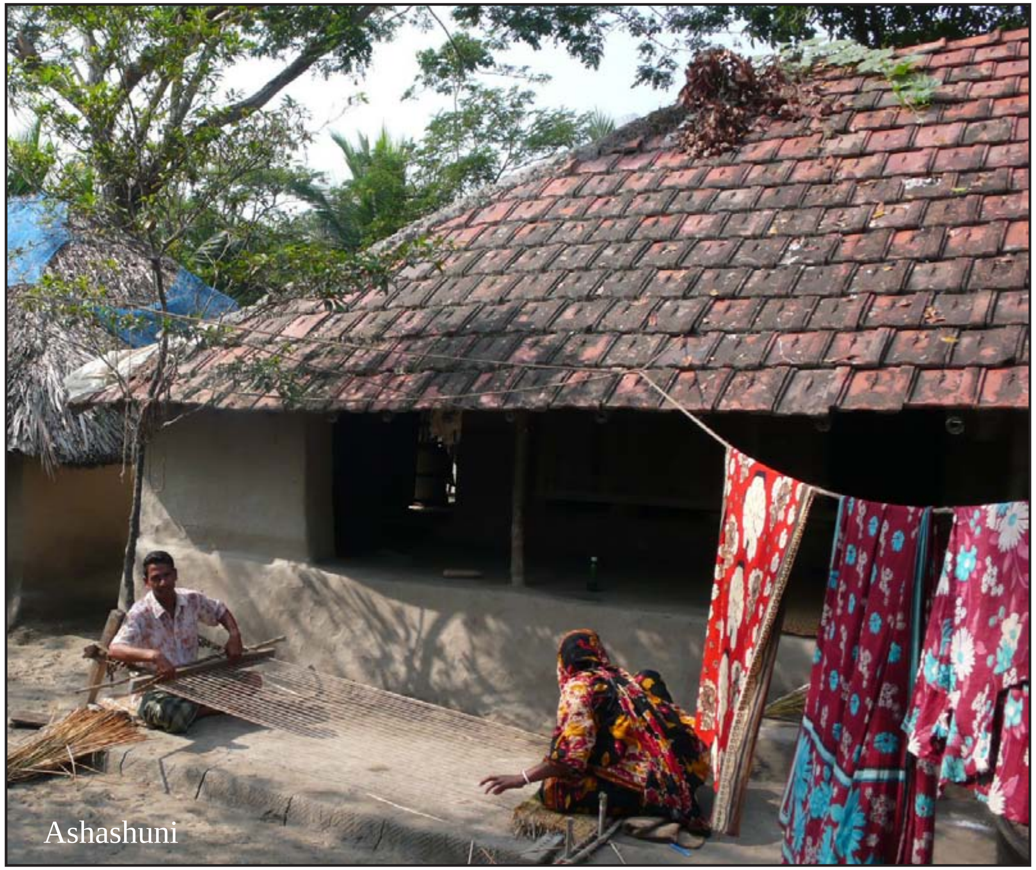
green roof choice



And replacement of iron sheet walls with green walls.

- Protection against salinity -

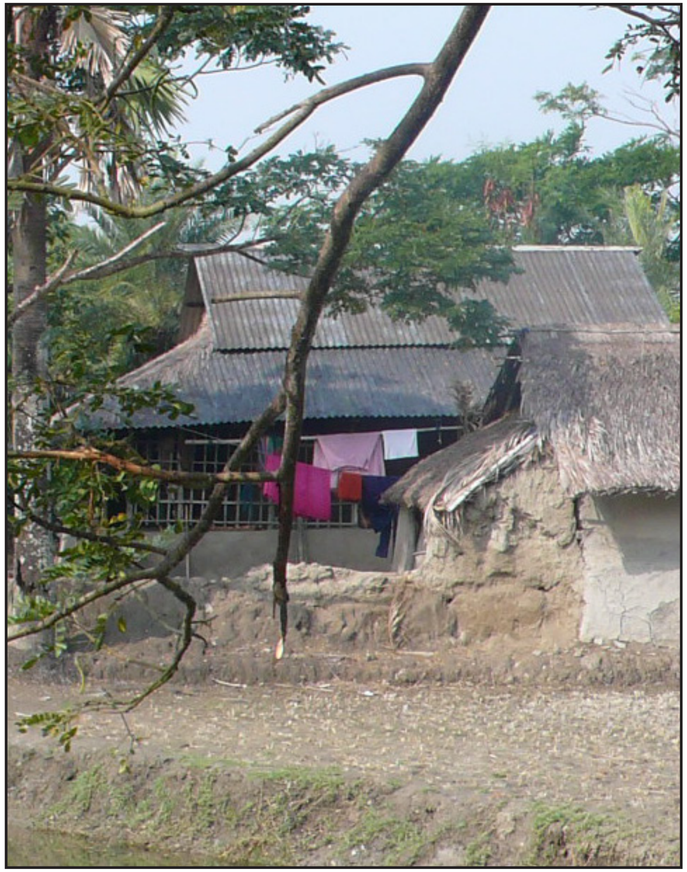
tile roof choice



And replacement of iron sheet walls with earth walls.

- Protection against salinity -

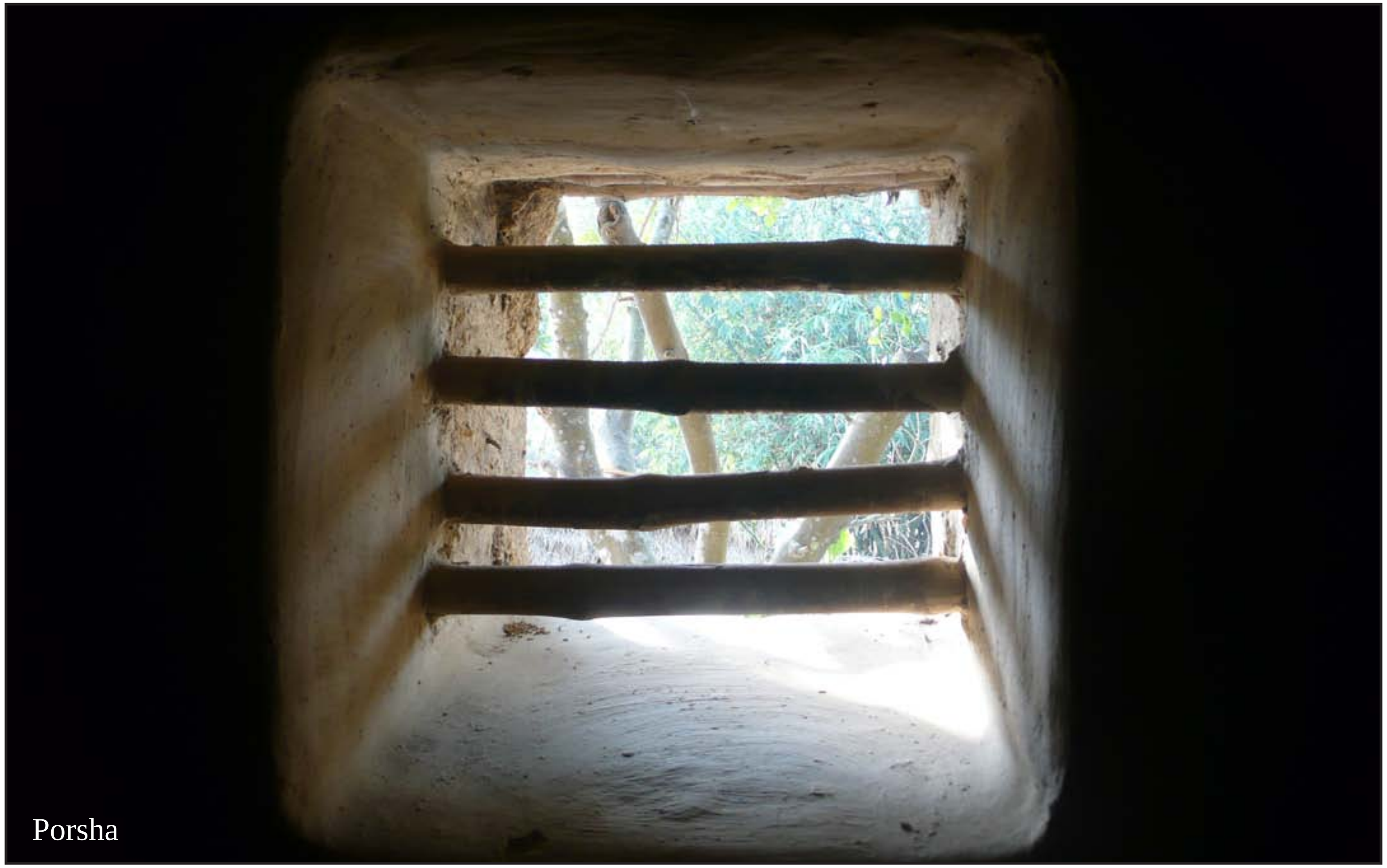
rustproof treatment for iron sheets



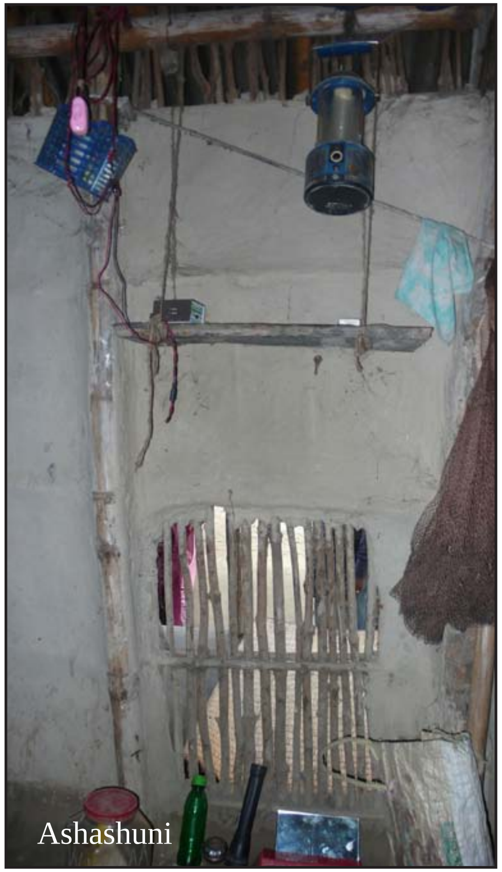
- THEFT -

- Theft prevention -

bars at the windows



Porsha

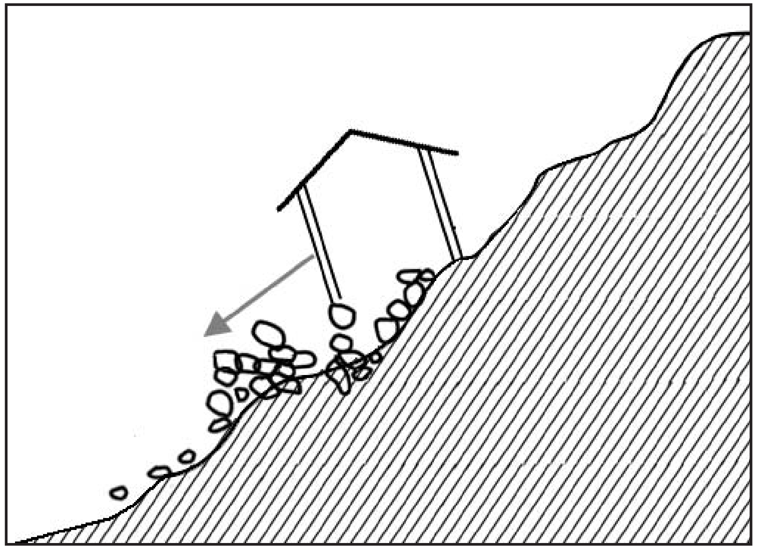


Ashashuni

By adding bambou bars at the windows or by keeping the wall structure free from earth filling.

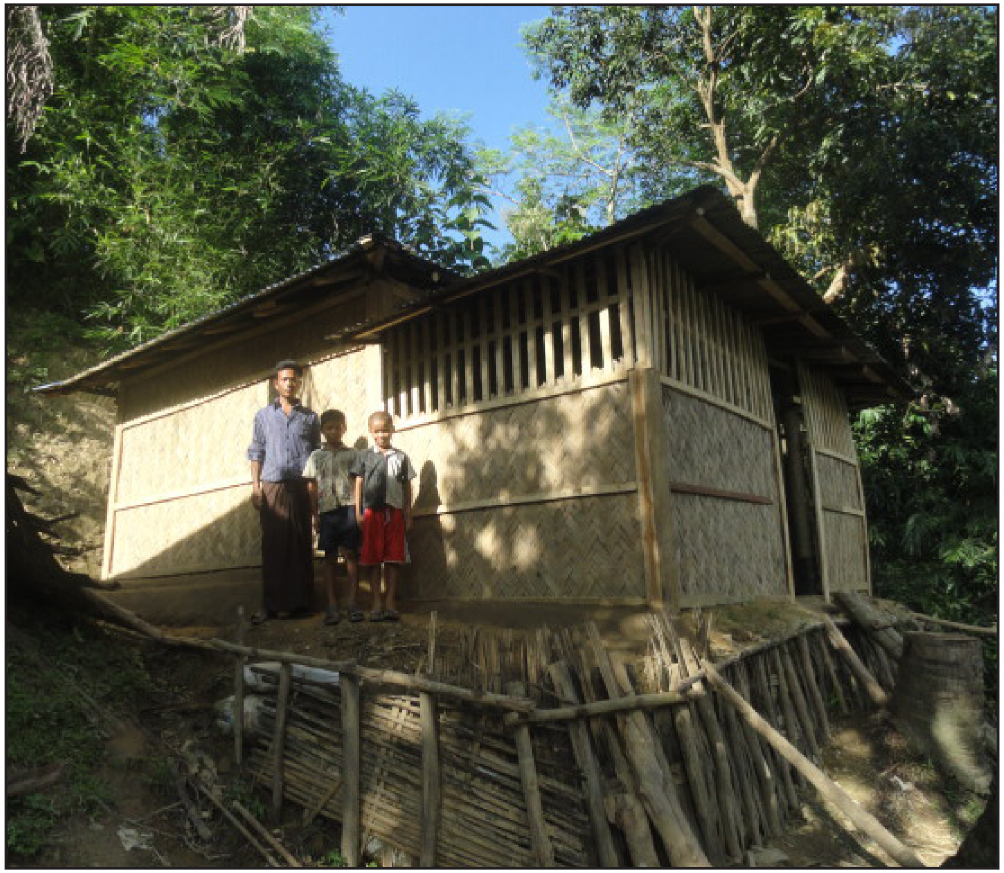
- LANDSLIDES -

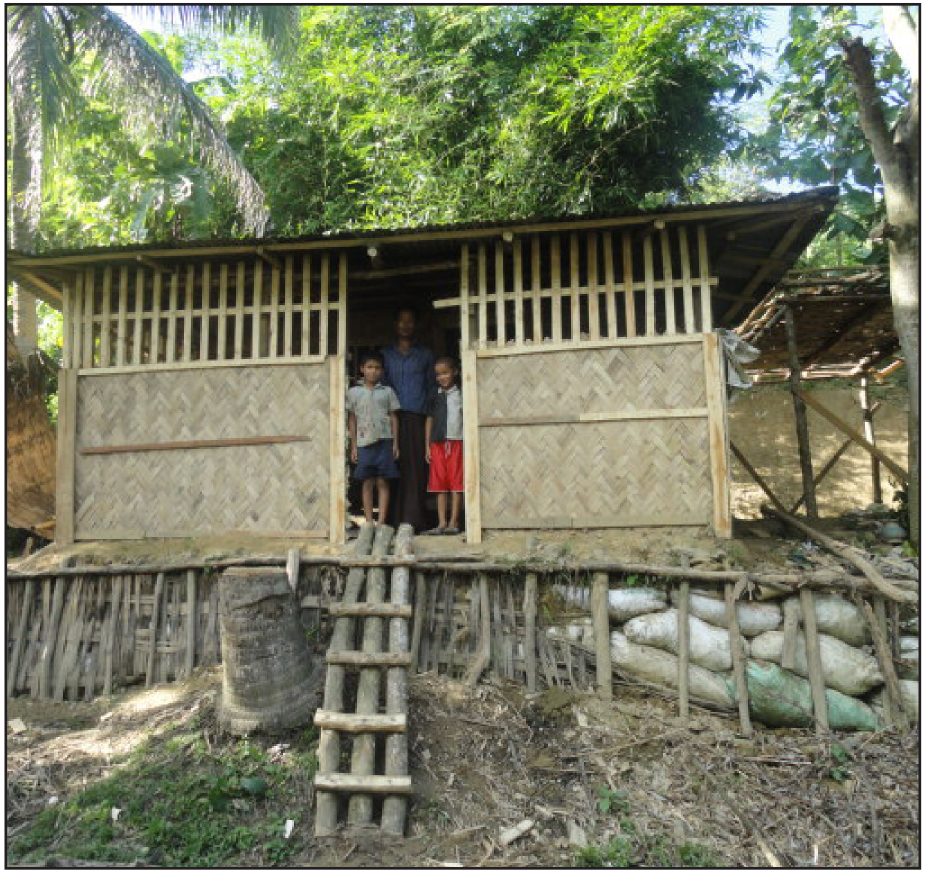
House sliding on a steep land



- Protection against house sliding -

implementation of a reinforced base

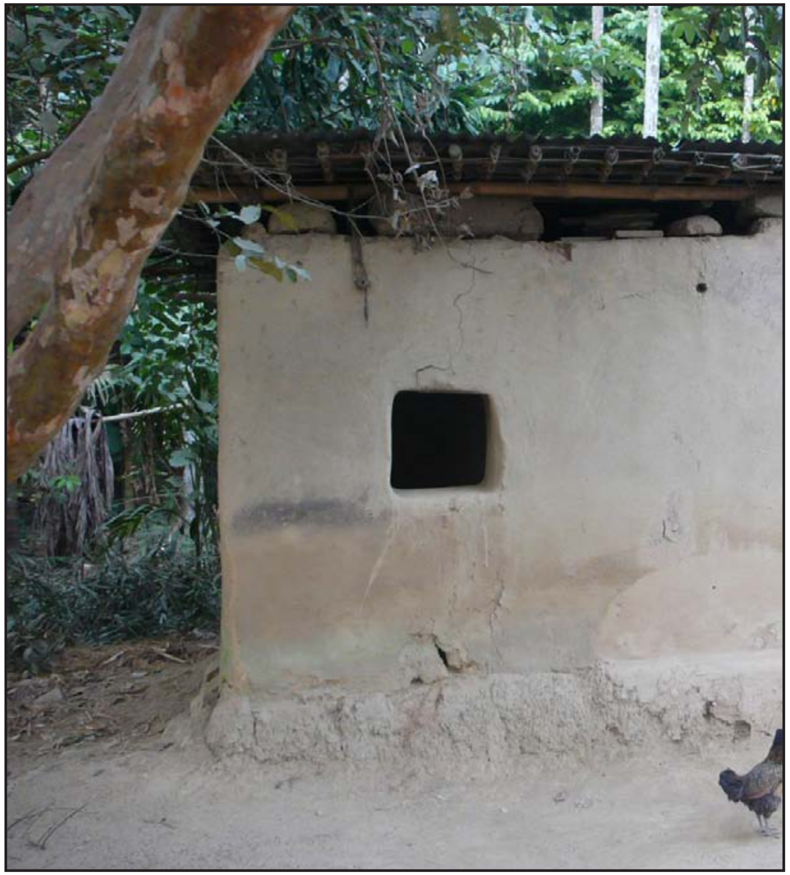


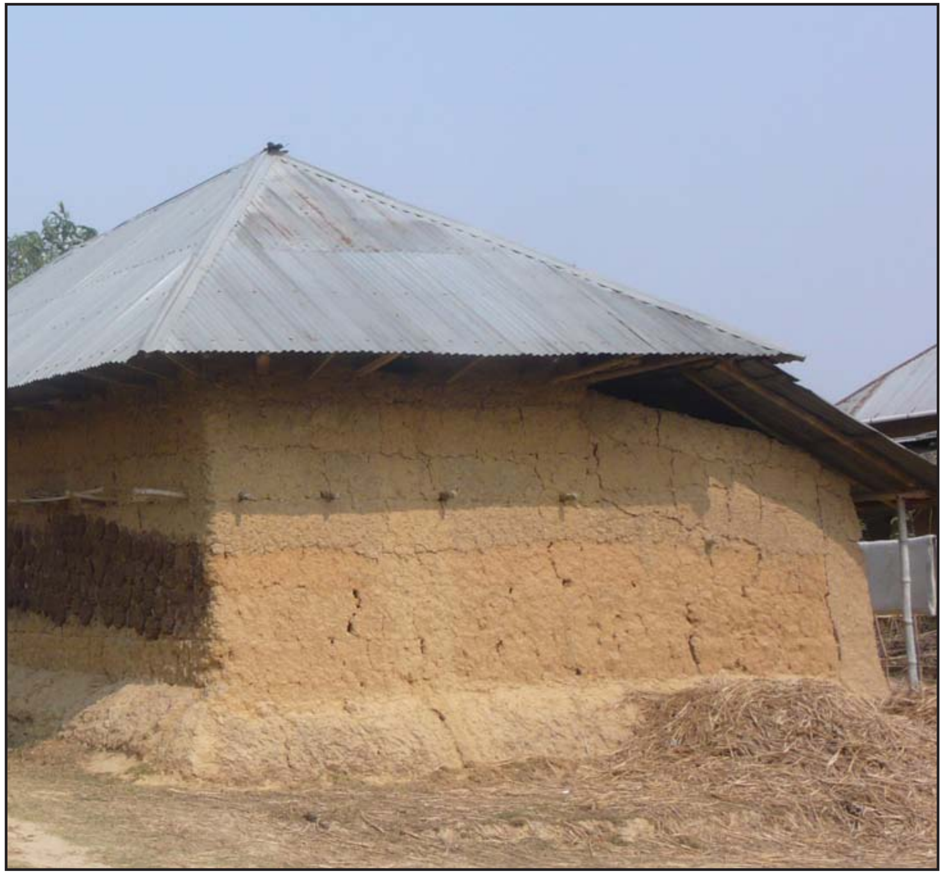


The house is built on a solid horizontal basement that is reinforced by heavy bags and inclined wooden poles which avoid landslides.

- HOUSE DETERIORATION ALONG THE TIME -

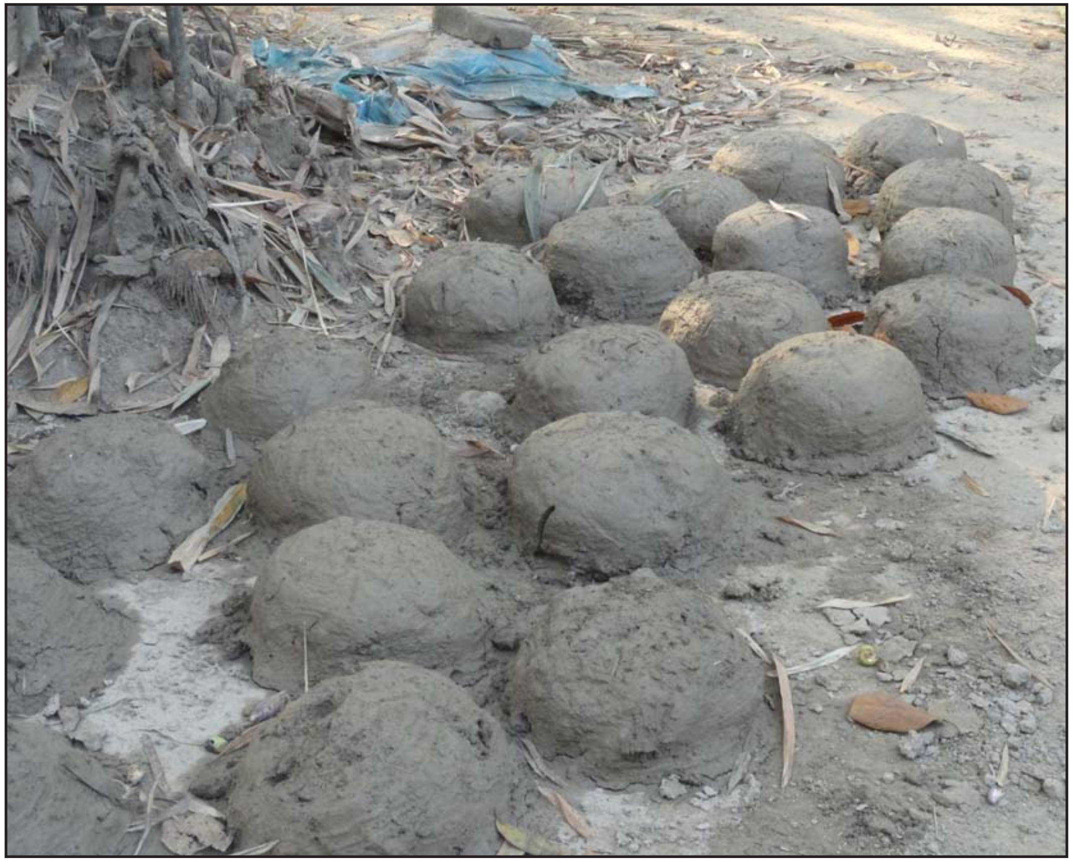
Walls deterioration due to the use

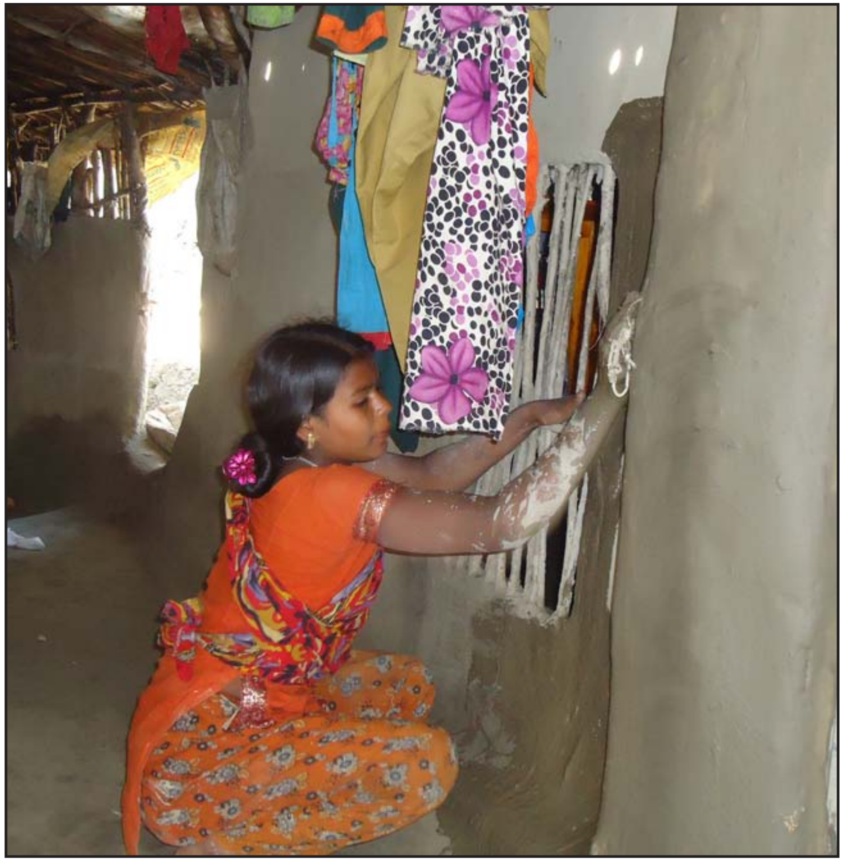




- House maintenance against wear and tear -

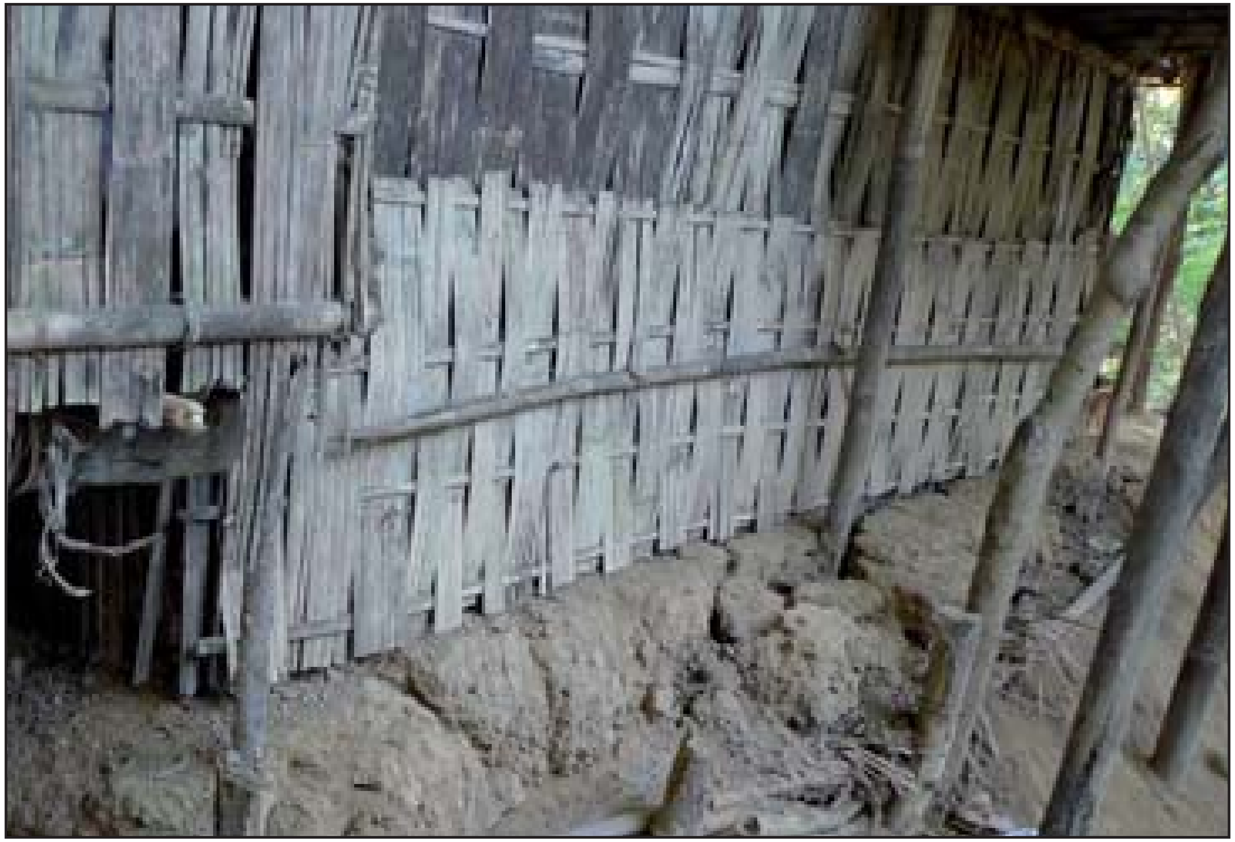
refurbishment of earth plaster





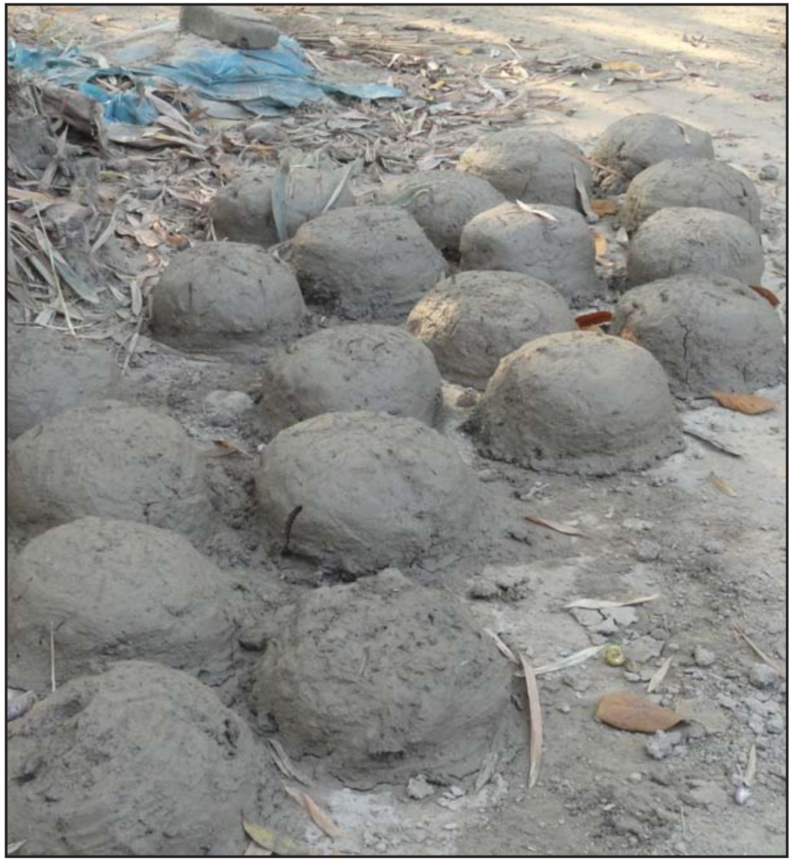
- HOUSE DETERIORATION ALONG THE TIME -

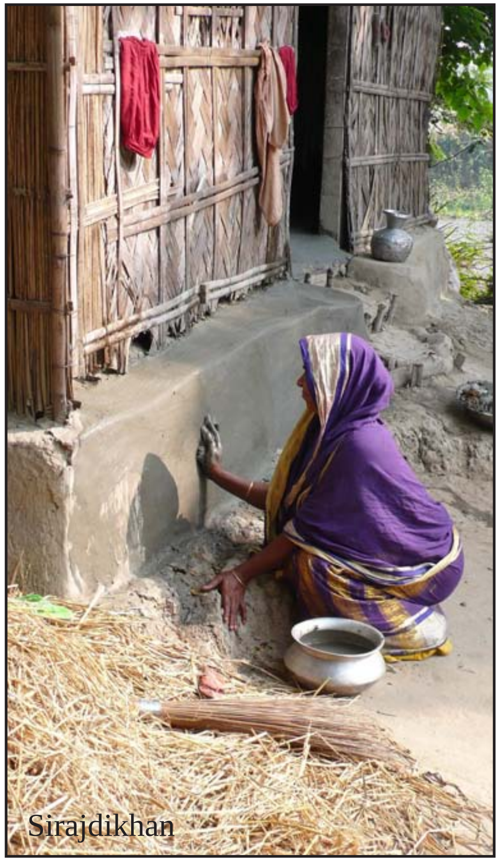
Platform erosion



- House maintenance against erosion -

reccurent platform protection with earth plaster





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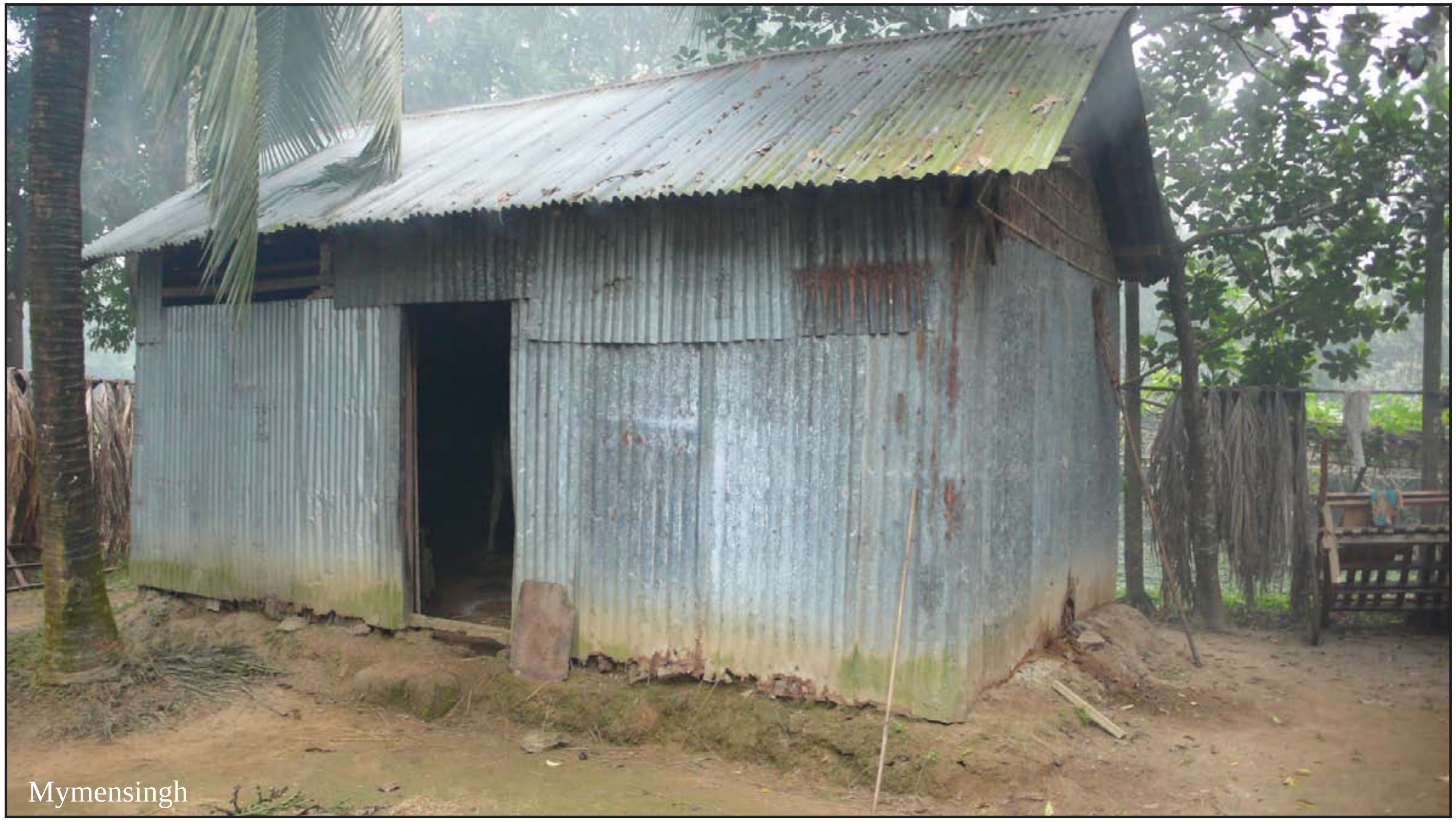
- HOUSE DETERIORATION ALONG THE TIME -

Rusted iron sheets



- House maintenance against rust -

rust protection in salty areas

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